VOLUME XXVII NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

FEBRUARY, 1915

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With 15 Illustrations

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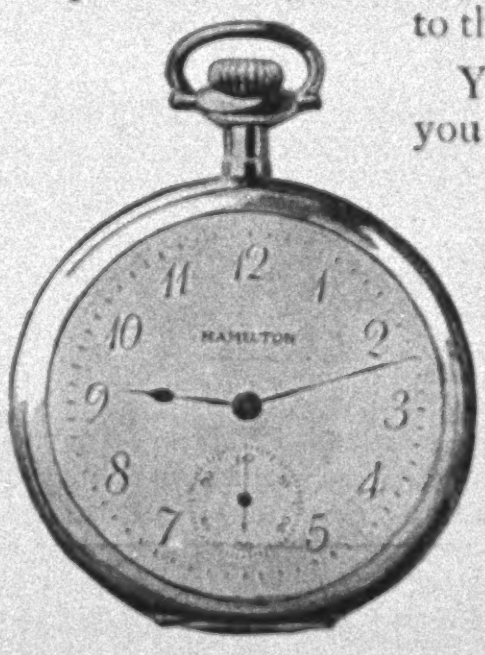

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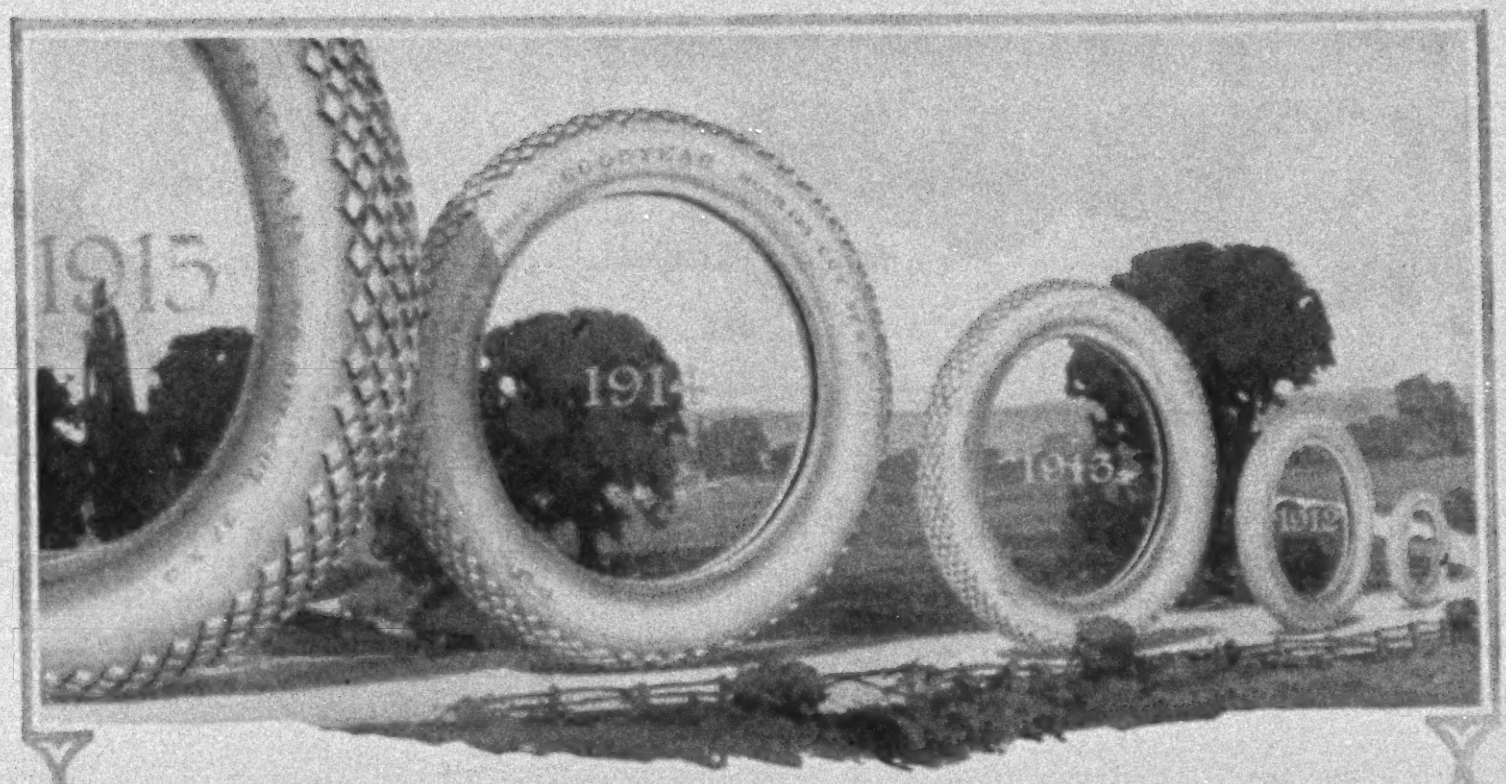

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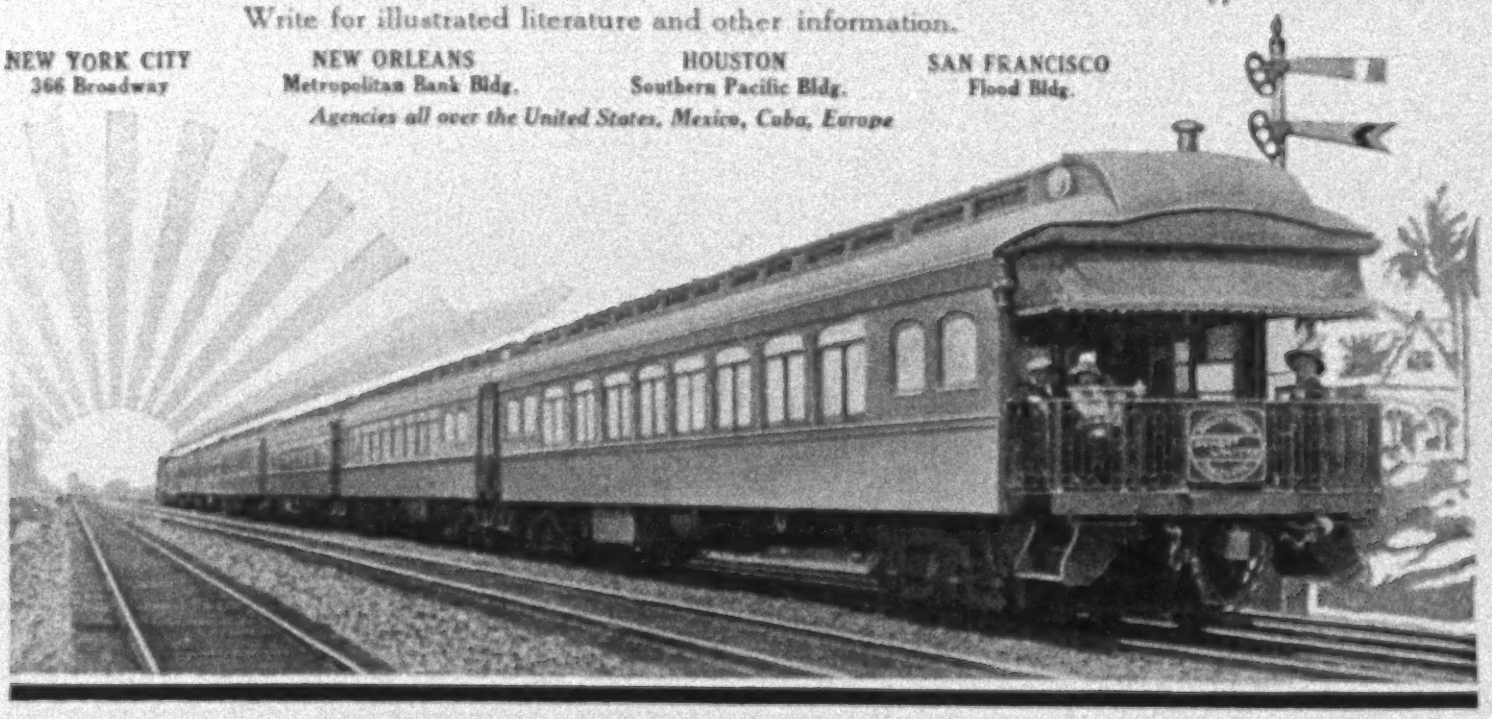

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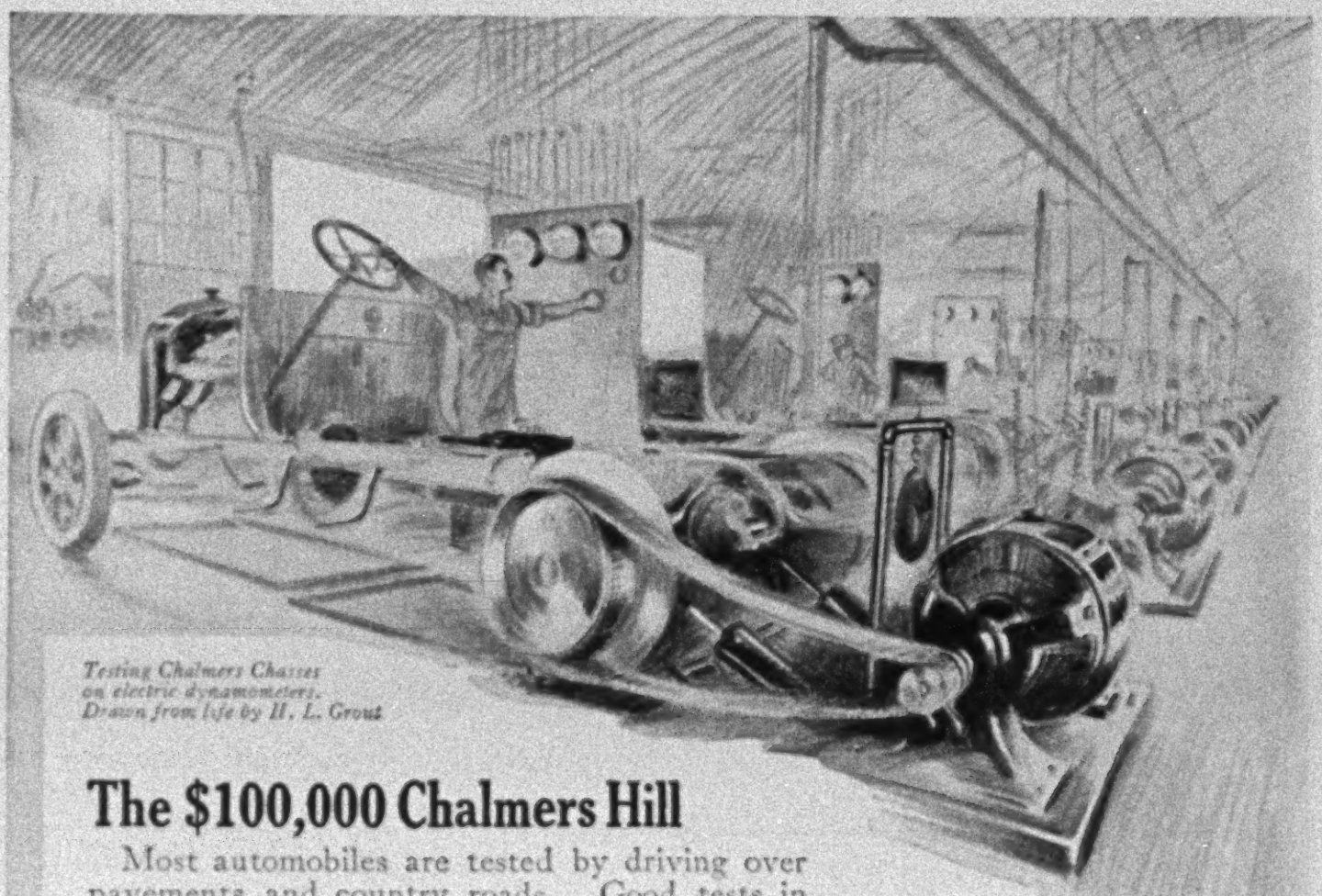

Testing Chalmers Chasses on electric dynamometers. Drawn from life by H. L. Grout

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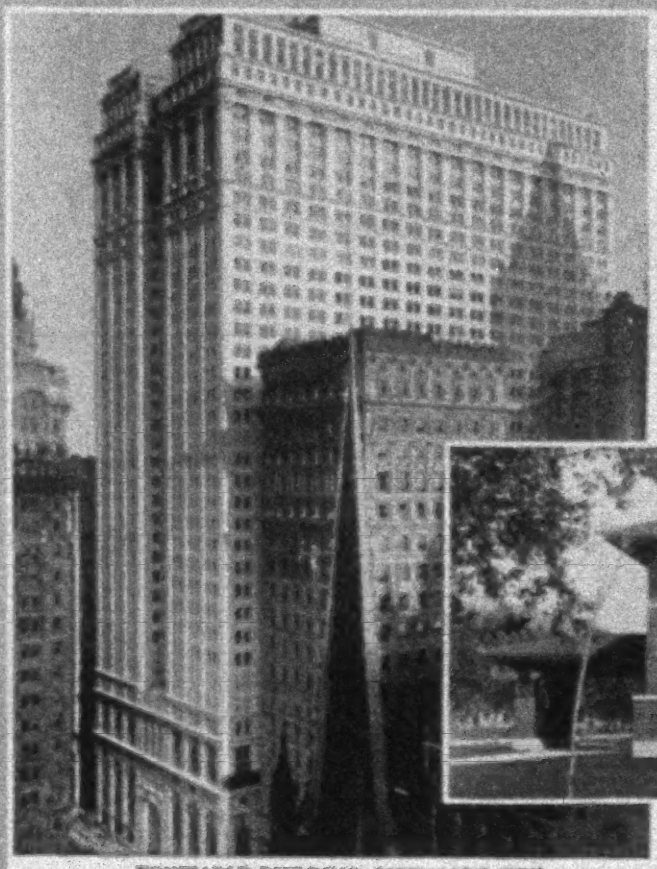

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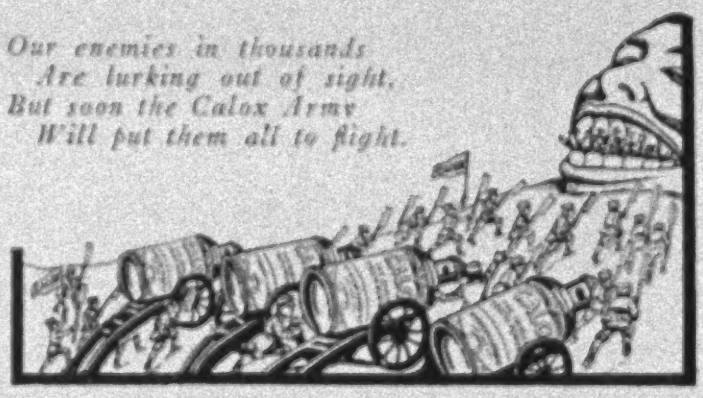

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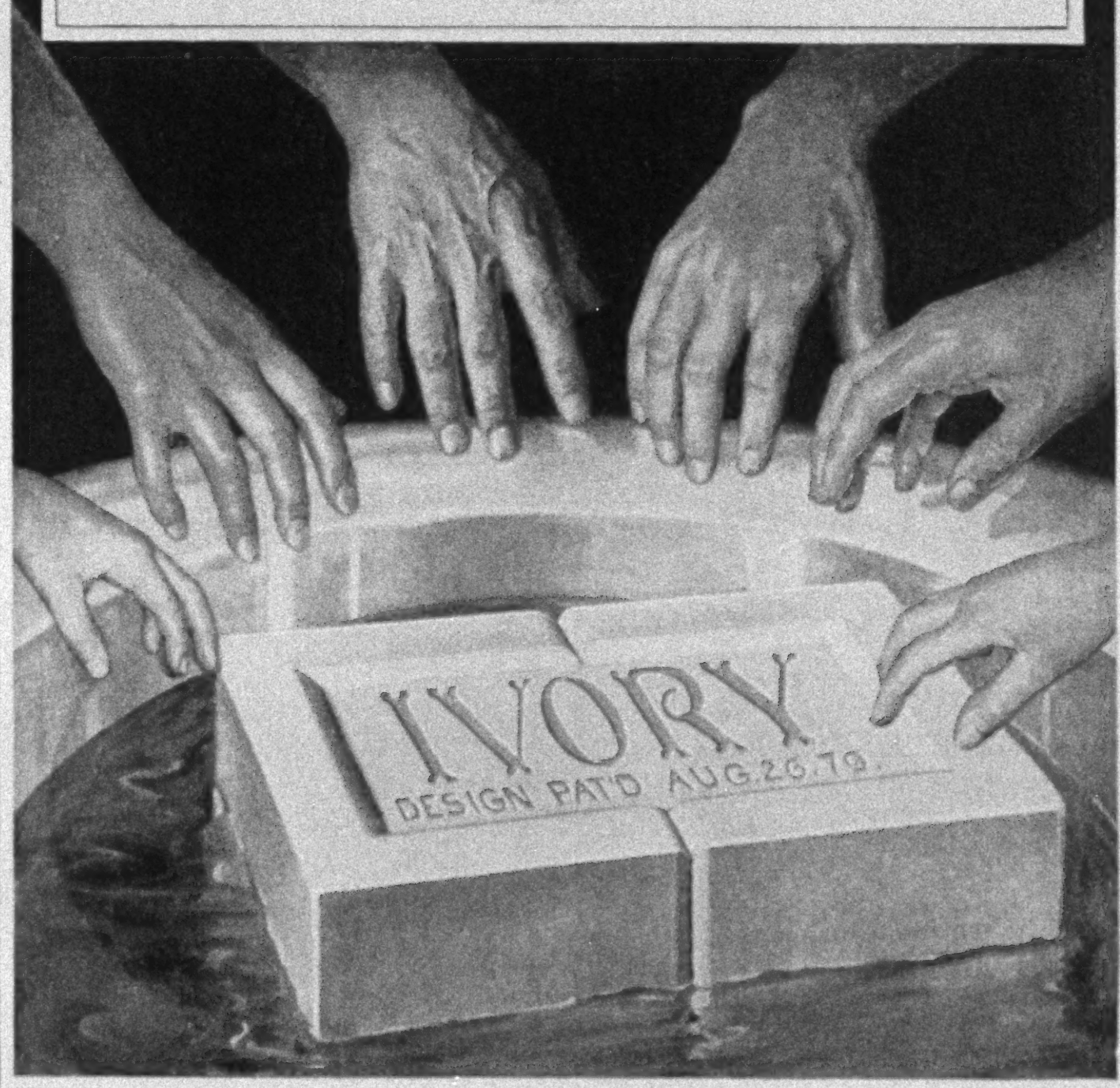


VOL. XXVII, No. 2 WASHINGTON FEBRUARY, 1915

THE NATIONAL GEOGRAPHIC MAGAZINE

THE TOWN OF MANY GABLES

BY FLORENCE CRAIG ALBRECHT

Illustrations from Photographs by Emil Poole Albrecht

Stolz im Aussern, rein im Innern
Daran soll dies Haus erinnern.
Gott mag immerdar hier schalten
Denn kann hier nur Segen walten.

Proud without and pure within,
May this house in memory seem.
May God here forever rule;
Then can only blessing reign.

THE memory of its winding streets, its ancient houses, gabled, arcaded, mottoed, had lingered with us since opportunity, one long-ago winter day, gave us two or three unexpected hours in the quiet city. We had thought it charming, even in its snow-mantle; unpretentious yet unmistakably prosperous; gravely contented and dignified; self-absorbed, yet not self-conscious; and we had always meant to see it again, and more thoroughly. When, then, an ankle painfully twisted upon a steep Malines stairway made our projected walking tour in the Harz Mountains very dubious, Münster appealed at once as a convenient and alluring half-way house in which to rest.

It is an eight-hour railway journey from Malines to Münster, with two customs-houses to pass *en route*. It must be stated promptly that neither Dutch nor German inspectors made any trouble for us, and the scenes in the examining rooms were rather entertaining than tiresome; but after one "passes customs" four or five times within a week, the funniest bilingual discussions lose flavor. The scenery through which one rides is entertaining, but not striking. Much of it is rich farm land, and farm land in June is lovely, wherever one may be; and we had seen this particular stretch of the Netherlands many times before. There was no novelty, which justifies our being very tired when we drove through Münster in the dusk one Saturday evening.

MERRY-MAKING IN MÜNSTER

June dusk in northern Germany, where the space between twilight and dawn is in summer so brief, means bedtime for early risers, and we were thinking drowsily of a dark, quiet room when our carriage turned into the Prinzipal Markt and stopped in a blaze of light. Münster was celebrating Jahrmarkt (annual market or fair)—the German version of the Dutch Kermis—and although the trinket booths and "shows" were clustered in the Dom Platz, the crowd of merry-makers, furnished with noise-producing implements, overflowed into all the adjacent streets.

We had no reason to be ruffled. We had chosen that hotel for its situation upon the Prinzipal Markt, so that, seated comfortably at our windows, we could lazily watch the ebb and flow of the town's life here at its heart. If the town chose to be especially lively during our stay, we should have been all the more

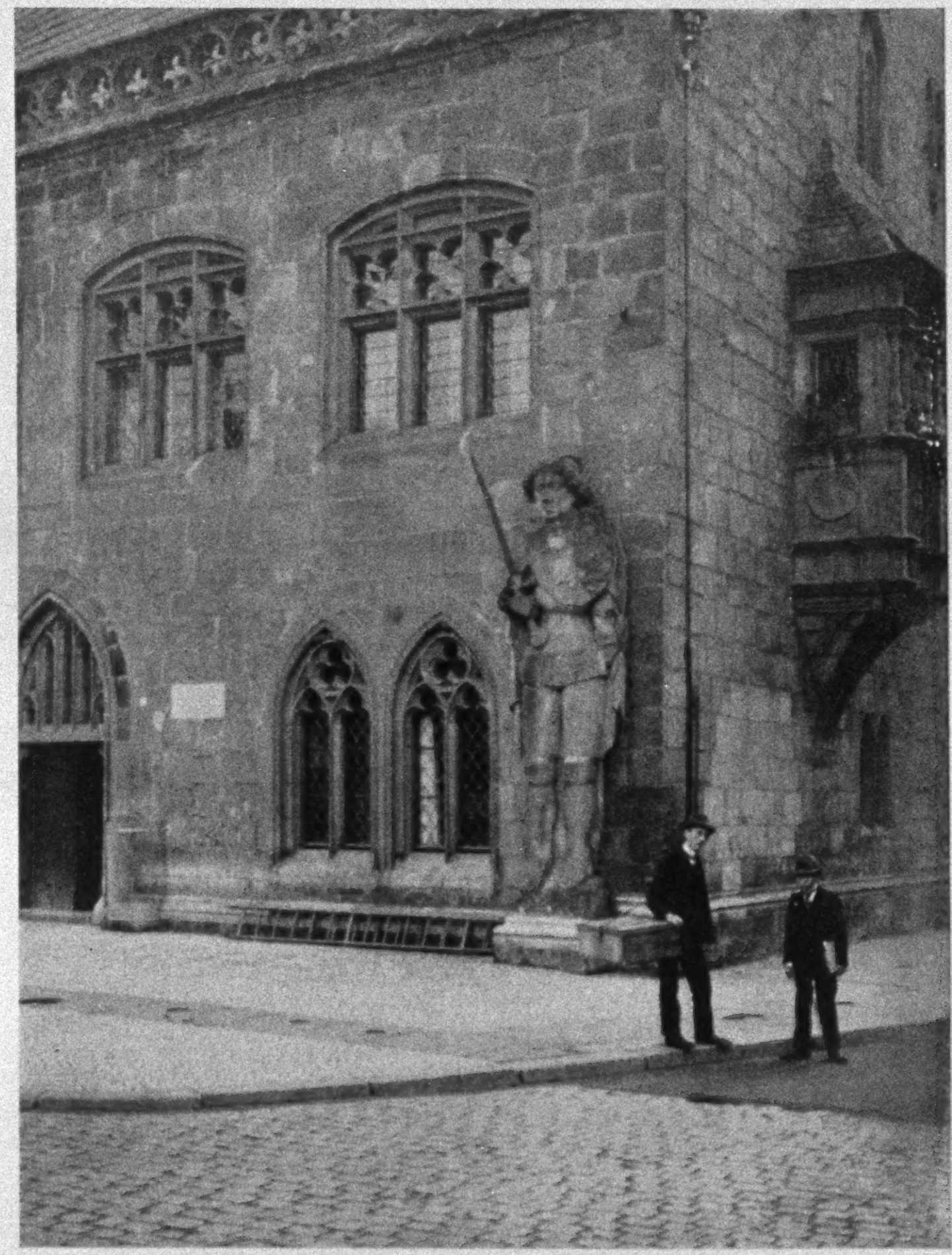


Photo by Emil P. Albrecht

THE ROLAND OF HALBERSTADT

This figure, which dates from 1433, is the symbol of municipal jurisdiction and the palladium of civic liberty. Similar figures are to be found in Bremen, Magdeburg, Hildesheim, Quedlinburg, Göttingen, Erfurt, Brandenburg, Haldensleben, Halle an der Saale, and perhaps other towns. It is usually placed against the Rathhaus or stands prominently in the market-place.

grateful; but I am not sure that we were. Did we think longingly of the quiet, luxurious caravansary at the station? Perhaps so. One always has to choose, in the smaller European towns at least, between the luxuries of the "best" hotel, with remoteness from the *Schenswürdigkeiten* (objects of interest), and the quaintness in situation or structure of its older inns, with a walk to the station.

NEW HOTELS AND OLD ONES

Of course, there are usually omnibusses, carriages, even occasionally motor-busses and taxicabs, to bridge the distances. The newest and finest hotels are usually built close to the station, upon that ring promenade, very likely, where once was the city's wall and beyond which the railroads never intrude; but the older inns cluster in the center about the market-places; old guild-houses sometimes, occasionally ancient palaces, oftener yet the town's ancient hospice, entertaining travelers since the days of pilgrimage and crusade.

While less luxurious than the newer houses, they are in themselves vastly more interesting, while their windows, small though they may be, look down upon livelier scenes than even the path to a railway station may offer. No elemental quaintness nor fragrant history lingers, however, about this particular hostelry upon Münster's Markt; neither does it house any of the discomforts of primitive times or inns. Less picturesque than many an other, it compensates with great comfort, and perhaps that noisy evening we were more pleased to observe its thoroughly modern furnishings than disappointed in its lack of "medieval atmosphere."

So comfortable were we that, in spite of noise from steam-piano, carrousel, horn, whistle, and drum; in spite of the glare of thousands of lights just beyond our broad windows, we soon fell asleep.

STREET-CLEANING DONE PROMPTLY

Sunday morning dawned with wet streets and threatening skies. We went out upon our balcony and looked up and down the silent street. Had we dreamt all the noise and gaiety of the night? The pavements, shining with wet reflections, were clean; no trace of litter, no peanut shells, no fruit rinds, no tattered ribbons or crushed flowers, such as usually remain for hours upon home streets after an outdoor festival, were anywhere visible. Either Münster does its street-cleaning promptly or keeps its streets clean.

The Prinzipal Markt, upon which our windows opened, is not, as its name suggests, a great open square, but an arcaded street, one link in a chain of curving streets and markets, which incloses the cathedral, the university, and other ancient buildings.

To the right we see the tall, delicate tower of the Lamberti Kirche thrust forward where the Roggenmarkt turns out of sight behind the tall gables. To the left, beyond the jutting balcony of the ancient weigh-house, the Rotenburg curves from view—a jumble of steep gray gables and scarlet roofs. We cannot decide which way lies the lovlier picture.

SUNDAY MORNING STILLNESS

The city is very quiet. A few early church-goers hurry under cover of the arcades to the cathedral or to St. Lambert's. A little girl trips by, in her arms a loaf of bread almost as long as herself. A small detachment of soldiers go down the center of the street with long, quick strides, turn a corner, and are gone. In the middle of the open space before the church a dog sits, yawning dismally. Is this all the "liveliness of the market-place" that we came to see? Münster sleeps late after its revels of the night, just gone.

Across the way are some charming houses, four or five stories tall, gray and gabled; some frankly old, other manifestly "restored." The ground floor is a shop, but the upper stories of the house extend above the pavement, resting upon pillars and arches; the effect is very pleasing to the eye, and in stormy weather the arcade is, for foot-farers, a great comfort. Watching one's neighbors is deplorable; only a showery morning in a strange town can pardon such lapse of good manners; any one too sensitive about such matters must not read the next lines.

As we looked over the rims of our coffee-cups at the delightful sky-line made by those curving, leaping gables, as we puzzled over the quaint text of the mottoes beneath them, we became aware that other eyes were looking over other cups toward our own. Münster, like us, was taking its morning coffee, and a little later Münster began, in spite of promised rain, to water its flowers.

FLOWER-BOXES AT EVERY WINDOW

All German towns can boast charming window gardens, but none—and saying it I recall very well the magnificent cacti of Rotenburg, Braunschweig's luxuriant geraniums (although that is not what she calls them), Quedlinburg's roses—are so lovely, so rich in bloom, as those of Münster.

Fancy a high, narrow façade of smooth, cool gray stucco dripping with purple blossoms from attic window to arched ground floor. The vine is apparently our large-flowered purple clematis; at least, seen from our window, color and flower shape are the same. Every window is massed with it, the long tendrils swinging and swaying in the light wind, the greenery almost hidden by the mass of bloom. Beside it a gayer building, gleaming with new paint and "restorations," finds its fresh colors rivaled by the pink blossoms in its window gardens, and beyond it a structure of dark gray stone makes a delightful background for a wealth of scarlet flowers.

And here and there behind each flowery screen one catches a glimpse of moving hands, of shining watering-cans, and sharp pruning-shears, sometimes of a friendly face. Usually the face is masculine; the master cultivates the flowers while the mistress is busy in the kitchen. Sunday dinner is too important to be left in a maid's incompetent hands.

Here and there are little blond childish heads bobbing behind the flower screen, and as the morning grows there are more and more of them peering down at the street, now filling with a gay throng. Does not every city have its "church promenade?" New York still throngs Fifth avenue after service, and Philadelphia once walked sedately to and fro upon Walnut street between Holy Trinity and the Philadelphia Club; Münster crowds the short space of its Prinzipal Markt of a Sunday morn, exchanging greetings and salutations.

READY FOR THE PARADE

But upon this Sunday of our story something more exciting was in prospect than the ordinary "church promenade." In spite of frequent vicious showers throughout the morning, carriages containing remarkably costumed young men rolled past our door, too swiftly for more than a glimpse of a white feather or the flash of gold lace, but frequently enough to keep our curiosity very high. Long before service was over people began to gather in the shelter of the arcades—people with arm-loads of flowers, who stood patiently, but persistently, holding their vantage ground in the front ranks, in spite of the increasing crush behind them.

Then bands of young students commenced to pass up and down the market, each group wearing its own peculiar *mütze*, signifying to the initiated the wearer's school and class. Müutzen are military-looking caps of odd shape, black visored, most of them; but the cloth crowns of every conceivable color—pale blue, scarlet, sea-green, yellow; or, when dark, with a vivid band. Each class of a gymnasium (secondary or higher school and each university student organization) has its peculiar cap. In a university town, where also are several gymnasia or preparatory schools, the rainbow scarcely furnishes enough variety of shades for all the caps, and where a group gathers together the bobbing heads look like grotesque flowers.

OUT OF THE CHURCH INTO THE RAIN

When the church doors opened after the last mass—Münster is devoutly Roman Catholic, her harrowing experience under John of Leyden having given her apparently more than enough of Protestantism—and the congregations poured out from the cathedral and St. Lambertus into the already crowded street, every vestige of pavement was lost from sight in the swaying sea of heads. Up and down the laughing, chattering crowd

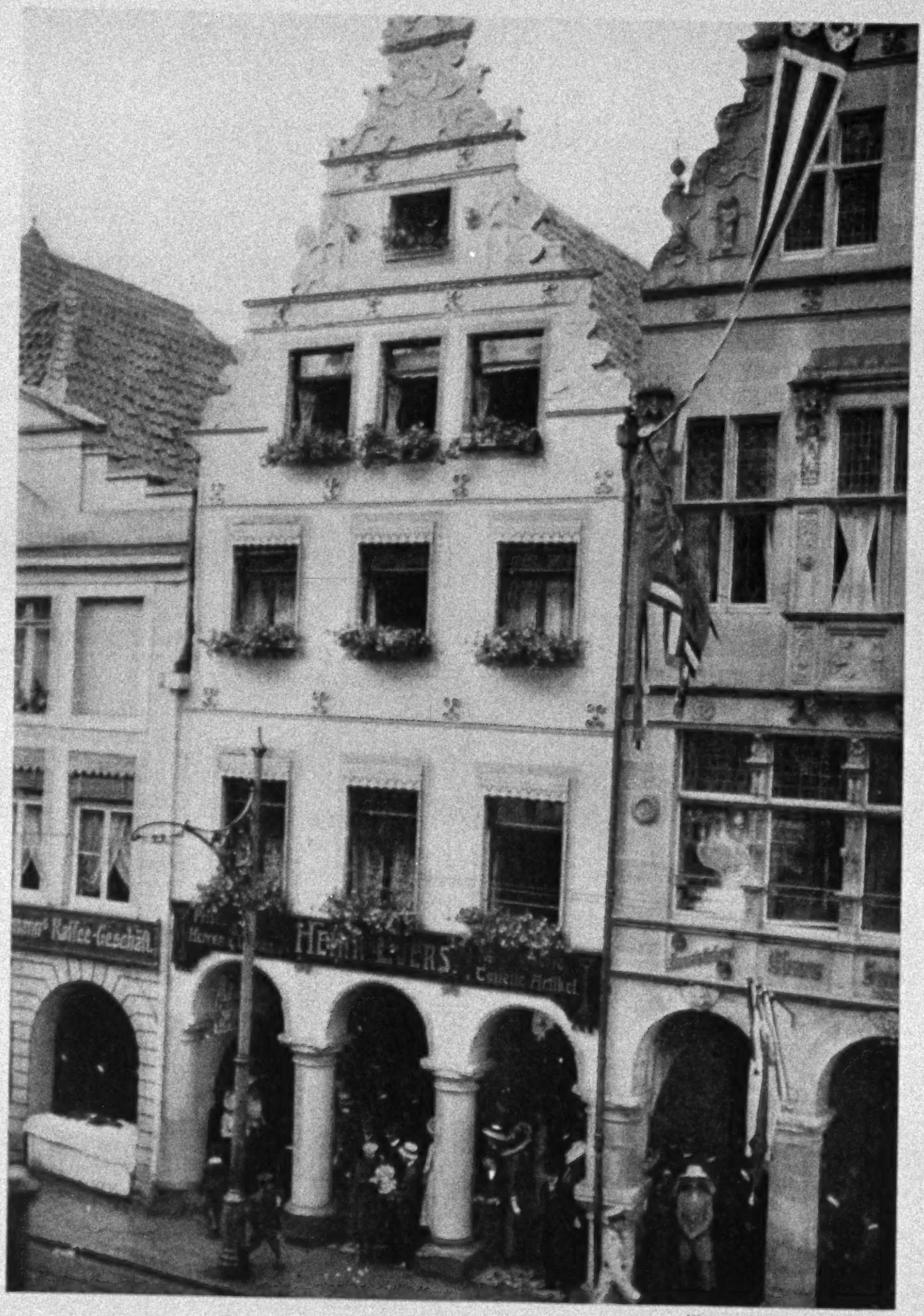


Photo by Emil P. Albrecht

THE GABLED HOUSES AND ARCADES WHICH BORDER THE PRINZIPAL MARKT: MÜNSTER

"Across the way are some charming houses, gray and gabled. Fancy a high, narrow façade of smooth, cool gray stucco, dripping with purple blossoms from attic window to arched ground floor" (see text, page 109).

surged, in spite of occasional rain, until music heard in the distance drew nearer and a narrow lane opened with difficulty in the center of the street.

Just then my chambermaid came into the room upon some errand and said that the "Veterans" of '70-'71 were parading that day, and that the student corps had joined the parade. "Will the procession pass here?" we asked eagerly. "Certainly," answered Gretchen with emphasis; "all parades pass here!" How stupid of us, to be sure. "And why do the students parade with the veterans?" we ask timidly. We are feeling a little ashamed of our ignorance now. "Don't know," says Gretchen; "they just like to! They are always parading!" Plainly, Gretchen doesn't think much of students. Probably her sweetheart is a soldier or policeman.

ALL HONOR TO THE BAND!

A blare of trumpets and the band appears curving in from the Rotenburg past the old Rathaus, just beyond us—a civilian band, attired in frock coats and high hats and mounted. Fancy playing a trombone, the reins of a restive horse, one's music card, and the heavy instrument in one's hands, and a gusty wind whirling around unexpected corners of a winding street! All honor to that band! It played well; no German band would dare do otherwise. Audiences are critical, and not a man lost his hat or his dignity.

Although it was the veterans' parade, the students appeared first, riding each in solitary state in an open landau drawn usually by two, occasionally by four, horses. Each wore a medieval costume, velvet apparently, and a soft velvet cap decorated with a long white plume, and each bore the banner of his corps, gorgeous affairs of silk, satin, velvet, gold lace, and embroidery. As the long line of carriages slowly passed, the meaning of the arm-loads of flowers became apparent (see page 114).

Very few large bunches or tied bouquets were presented, but each student received from his friends along the line some floral token—here a single rose, there a handful of carnations, then a tiny bunch of sweet peas or pansies or a couple of stately lilies. The students thanked each giver with a more or less gracious and graceful bow—as the banners were very heavy and awkward to manage, one must not be too critical—and laid the blossoms in the open top of his carriage. There were favorites in the university as elsewhere; one man had his carriage heaped with flowers, while another would have scarcely half a dozen tokens of good-will and popularity.

THE VETERANS ARE MARCHING BY

Long before the last gay carriage passed, the rain fell in torrents, velvet and feathers were draggled, summer frocks drenched; but neither paraders nor observers flinched. After the students came the veterans, a little somber group, passing along on foot, quietly and slowly, pathetically, like other "veteran corps" we have seen at home. There were neither banners nor flowers for their share, although it was their parade. We were glad that they were not without friends, however, and that applause greeted them all along the line as they marched bravely by.

All the participants had shared in an especial service at the Dom before parading; that accounted for the hurrying carriages earlier in the morning. Now, after a circuit of the old town, the procession would break up in front of St. Lambertus and carriages and veterans find their way home through the crowded, dripping streets.

An hour later and the market was as quiet as in the early morning. Münster was dining. Then it would nap, and then drink coffee, after which it would be ready for church and amusement once more. Being merely Americans, we thought it best to use the sunshine which greeted us after dinner for a little sightseeing.

SURE SIGNS OF MARRIAGE

For an hour we had the streets quite to ourselves, but later smiling family groups began to pass us—father, mother, and a troup of chubby children; young couples arm-in-arm, newly engaged or married (one knows whether it is "en-

Photo by Emil P. Albrecht

THE RATHHAUS, IN THE PRINZIPAL MARKT, MÜNSTER

A beautiful Gothic structure of the fifteenth century, which contains the "Friedens-Saal," where the Peace of Westphalia was signed on October 24, 1648

Photo by Emil P. Albrecht

THE STUDENTS' PARADE: MÜNSTER

"Each sat in solitary state in an open landau. Each wore a medieval costume of velvet and a soft velvet cap decorated with a long white plume, and each bore the banner of his 'corps'—gorgeous affairs of silk, satin, velvet, gold lace, and embroidery" (see text, page 112).

Photo by Emil P. Albrecht

SCENE IN FRONT OF THE CATHEDRAL AFTER THE SUNDAY MORNING SERVICES IN MÜNSTER

When the doors of St. Lambertus opened after the last mass and the congregation poured out into the already crowded street, every vestige of pavement was lost from sight in the swaying sea of heads. In the window just above the clock face are the three long iron cages in which the bodies of John of Leyden and his associates were exposed (p. 117).

Photo by Emil P. Albrecht

A LAST RELIC OF THE ORIGINAL FORTIFICATIONS: MÜNSTER

Where the walls once stood is now a lovely promenade, and swans, with their growing family, swim placidly in what was the old moat (see page 117)

gaged" or "married" by observing if the girl leans upon the man's right or left arm)—going to the parents for the sociable coffee-drinking, an every-day function, which upon Sunday receives a pleasantly, leisurely, holiday flavor and offers convenient opportunity for offering light refreshment to one's family and friends.

From our vantage spot on the balcony we had noticed now and then some passer stop and gaze intently at St. Lambertus' tall tower. Several times our eyes swept its tall height; yes, it *was* undeniably lovely, graceful, altogether satisfactory, as it soared upward from the market, but these people who looked longest did not look like students of picturesque architecture.

Finally we discovered the objects their eyes were seeking—three long iron cages swinging just above the clock face on the tower. They recall Münster's most harrowing days, those when she went mad with frenzied religious zeal and followed blindly the vicious teachings of John of Leyden.

It is unjust to saddle upon a sect the evils practiced by its leaders, but all Anabaptists suffered in reputation and Münster in stern reality by reason of the vicious excesses there indulged in by this John of Leyden and his associates. The wild orgy ended with John's overthrow. He and his chief intimates, Knipperdollinck and Krechting, died by torture and their bodies were exposed in these iron cages upon the stump of St. Lambert's older tower, for this present graceful structure has scarcely been finished a decade.

A CITY WITHOUT A TOWER

In the brief period of John of Leyden's rule, all of Münster's church towers were demolished by his order, so it is said; only St. Lambert's was stout and strong and could not be entirely destroyed. Very recently some one spoke of Münster as the "city without a tower," and that may well have been the case in the years directly after this religious upheaval, but not today; Münster boasts many graceful towers and spires.

Beside St. Lambertus is a charming little fountain, a children's fountain, its basin carved with quaint nursery rhymes and a ring of chubby marble children, not cherubs, nor fairies, but lovable every-day children, frolicking around the splashing water. Usually it is encircled by living children as well, scrambling and clambering up the basin's sides, dabbling eager hands in the pool, or gazing open-mouthed at their marble representations. The Ludgerus fountain by the cathedral is more celebrated, but this one in the Lambertus Platz is our favorite.

Münster has several beautiful churches besides the Dom, the largest and finest church in Westphalia, notably Ludgeri-Kirche, older yet than the cathedral in part, and the beautiful Gothic Ueberwasser-Kirche, more rhythmically the Church of Our Lady. The cathedral (St. Paul) was built in the thirteenth century upon the site of an earlier church, traces of which may still be found by antiquaries; but the later additions made in the sixteenth century are far more apparent. From some corners of the great tree-shaded Domplatz the edifice is very beautiful, from others unimpressive; but the whole space about it was so crowded with booths that we scarcely saw it fairly.

MÜNSTER KEEPS THE SABBATH

The booths were all closed and the carrousels silent, for Münster keeps the Sabbath, so far as buying, selling, and noisy merry-making is concerned. A few fakirs plied their trade in the cathedral's shadow. The most popular was a man selling small flutes, upon which he played folk-songs to attract buyers. He drew a sweet, bird-like note from the tiny thing and with such ease that his wares found many sales. It was very amusing to watch the interested faces in the group about him and the sheepish glances buyers cast about them as they essayed to try the toy for themselves.

Münster's old walls and gates are all gone. One or two plain old towers alone remain of all her stout fortifications. Her "Rampart-promenade," a ring of small parks crossed at intervals by well-paved city streets, takes the place of walls and moats, and from it American cities could well learn the art of landscape gardening within narrow limits.

Nowhere are these parks of great

Photo by Emil P. Albrecht

AN OLD TIMBERED HOUSE, WITH ELABORATE CARVING AROUND THE DOORWAY: THE MÖNCHE-HAUS, GOSLAR

Note the figures of Adam and Eve. No street is without one or more of these quaint buildings

width, yet frequently they give the impression of distance, and beautiful breathing places they make for a population which has long since outgrown the town's ancient limits. Water fowl find homes in the rippling pools that adorn them, ducks and swans so entirely at home and unafraid that, after an inquiring glance up and down a street, they do not hesitate to cross it upon their way from pool to pool (see page 116).

A SUNDAY THRONG

Flowers and shrubbery, smooth green turf, and thick-foliaged trees lined the quiet walks; sweethearts and little romping children; old people, slow and patient of step; parents with growing families; soldiers; students, bold and assertive; coquettish nursery maids out for an airing; school girls, blushing and giggling—all to be met with on a holiday afternoon.

Adjoining the ring of promenades is a stately Schloss, once the residence of Münster's proud prince bishops, but now belonging to the crown, and beyond the promenades are Münster's most charming residences, each with its garden, large or small, but always flower-filled and always with a tiny veranda, or arbor, where the family are drinking coffee this sunny afternoon. Münster's merchant princes have always been well housed. In the older town are some very stately *höfe*—literally, courts or courtyards, but actually very handsome sixteenth-century residences built on three sides of a grilled court.

There is a museum with pictures, but Münster's best pictures are not in her gallery—they are in her streets and markets. Of course, it is not always fair time. There are not so many flags and flowers; very rarely one sees a costumed peasant or such lively crowded streets. The Westphalian costume is fast disappearing; it is remarkable rather than pretty, and will be no great loss save for the element of individuality and quaintness it gives to busy market-places. Very rarely one sees it in Münster, not frequently even in the villages.

On Monday morning market was in progress under the arcades and by the curbs of the Prinzipal Markt, but a drizzly rain was falling, the sky was murky gray, the flags were twisted and tangled, everybody wore their dull work-a-day clothes; the Jahrmarkt booths were deserted. Probably at night the fun and noise were renewed, but we did not wait for it. "Will it rain all day?" we asked the porter anxiously. "Surely," said that worthy positively. So we packed our bags, cast one lingering glance at the blossoms and mottoes across the way, and went on to Hildesheim, ere sober reality dulled the brightness of the holiday.

BEAUTIFUL HILDESHEIM

And Hildesheim is assuredly a jewel of a town, well calculated to make one forget another's charms. Who shall truly picture her delightfulness; her winding, narrow streets; her tall-timbered houses; her market-place, walled by stately dwellings, by Rathaus and Amthaus; her open places ringed by bewildering gables; her tall, grave churches and grim old towers. How many fascinating legends, churchly and pagan, one may hear there. Who can forget the rose bush of a thousand years or the bells of the Kehrwieder (turn again) tower? Who does not fear "the Huckup"? Admitted to intimate acquaintance with Hildesheim, it is indeed difficult to look equably on her rivals.

Yet there are a score of towns which might readily dispute with her the right to be remembered, and, with Münster, all claim to our title. Braunschweig, for instance, more of a city, more flagrantly modernized, has nevertheless had the grace to preserve much of her ancient splendor. For entirely personal reasons we love her better than any other gabled town, and, except when we are in Hildesheim, think her by far the loveliest; less of romance gilds her, perhaps, but much stately history clings to her old burg; while Till Eulenspiegel's merry pranks and incidentally his owls and monkeys, both gingerbread and bronze, still enliven his old neighborhood.

MODERNITY AND MEDIEVALISM

If the electric lights and very modern plumbing of Braunschweig's best hostelry inform you that the town is distinctly up to date, there are also, not five minutes

Photo by Emil P. Albrecht

A CORNER OF AN OLD GABLED TOWN IN GERMANY

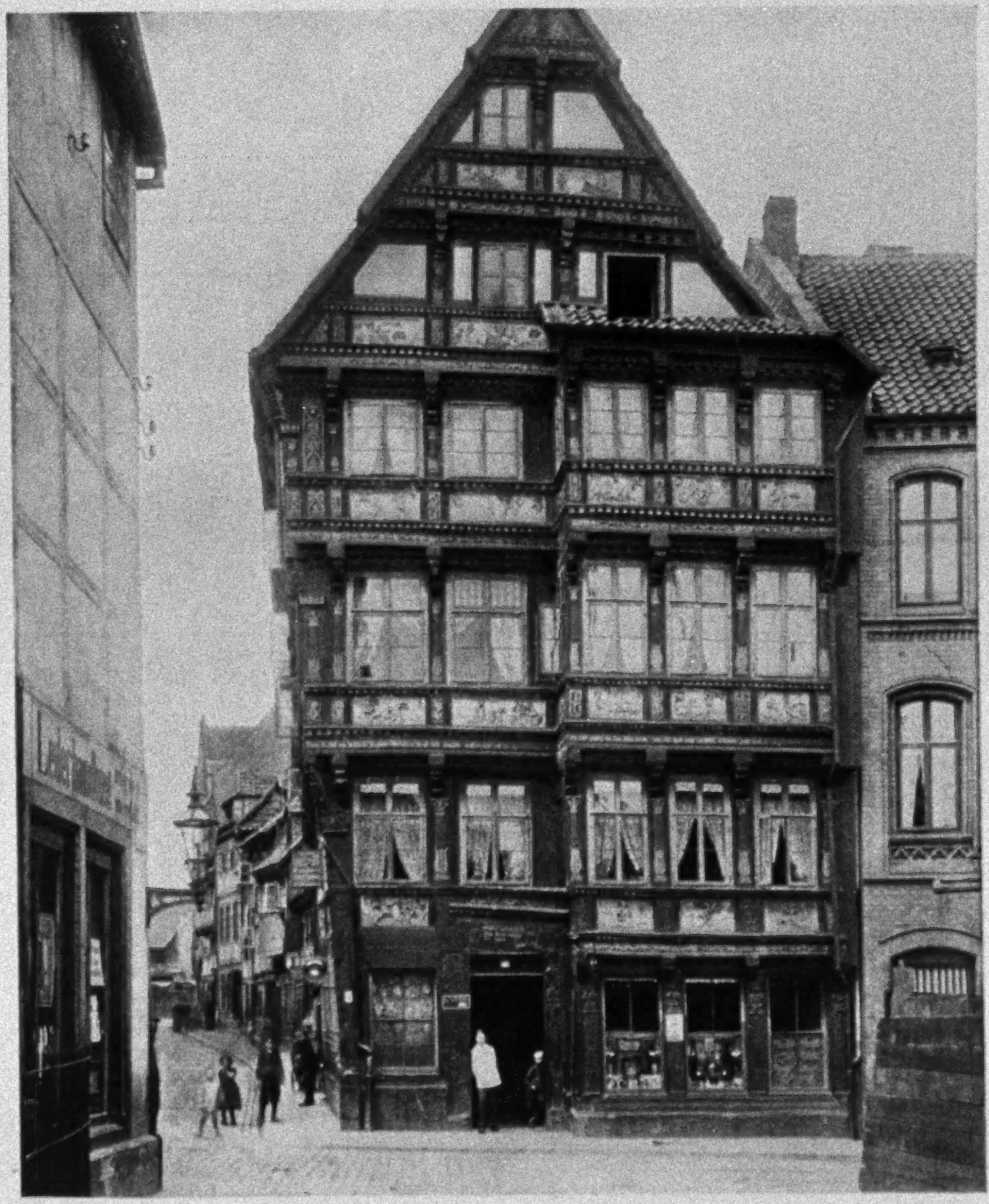
Photo by Emil P. Albrecht

THE FINKENHERD IN QUEDLINBURG

It was in this open space that Henry the Fowler was found snaring finches, by the deputation come to announce his election as king—so it is said. Even if the story about Henry the Fowler cannot be substantiated, it is a pretty one, and there are still lots of finches here today, both in cages and making homes in the vines.

ANCIENT GUILD HOUSE OF THE BUTCHERS: HILDESHEIM

This remarkable old guild house, called "the Knochenhauer Amthaus," which, literally translated, means the "Bone-Hewers' Office House," is considered one of the finest timber structures in Germany. It was built in 1529, restored in 1884, and now serves as a museum of industrial art.



ROLAND HOSPITAL AT HILDESHEIM

Hildesheim is one of the few northern German towns that have steadfastly refused to grow young according to modern utilitarian methods. It has preserved its rare old timber structure, with their lavishly carved friezes, stanchions, and cornices, and their impractical, red-tiled gables. There is a modern, straight-front, brick-and-mortar, drably practical house beside the Roland Hospital, and the comparison between the old and the new thus afforded is the best excuse for Hildesheim's conservatism.

AN OLD CITY STREET IN HILDESHEIM

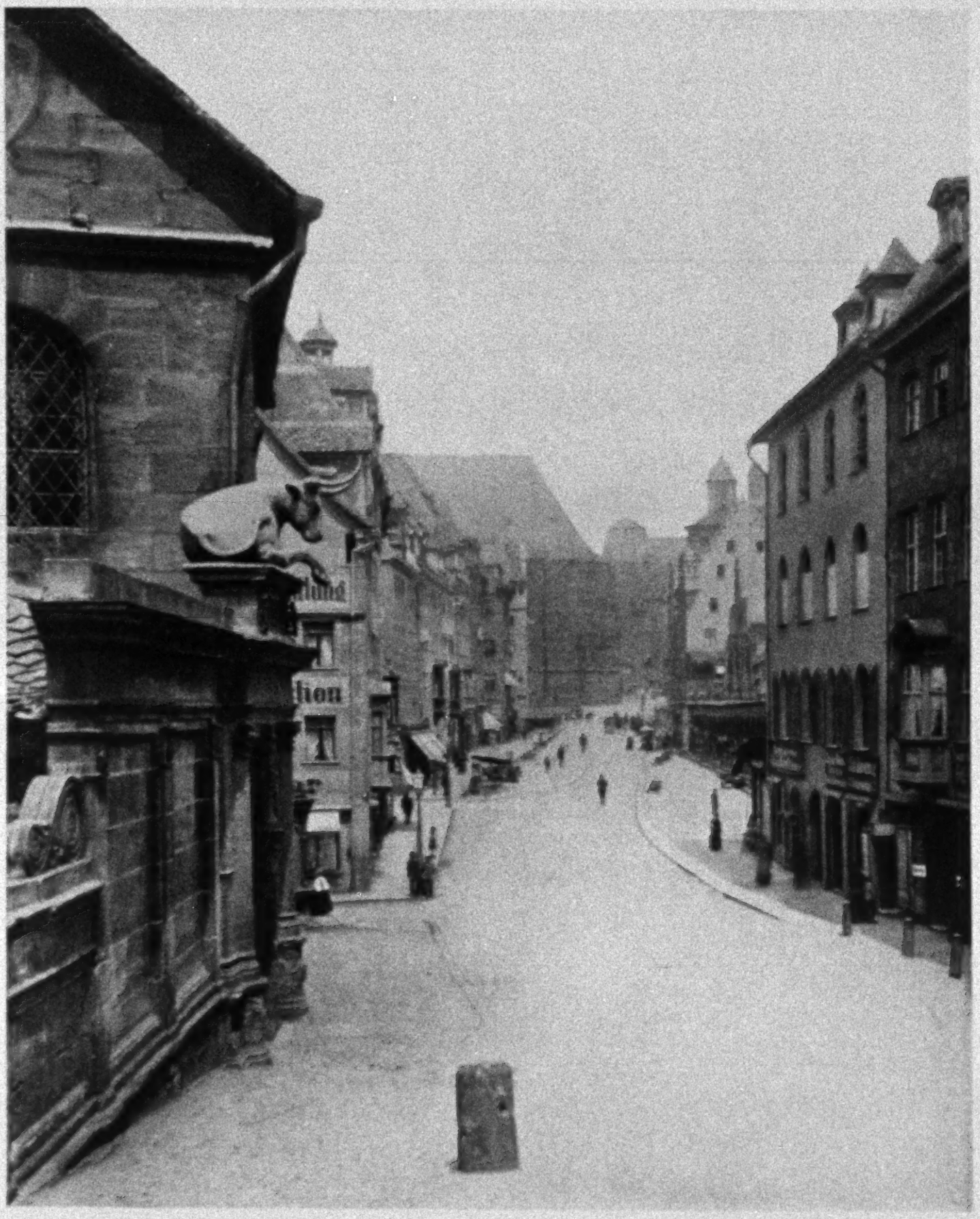
European city-builders in the Middle Ages considered matters of street construction to be of little importance; the municipalities laid out the fortifications and the moat, individual inspiration created the dwellings, and the streets took care of themselves—they were whatever lanes that happened to remain between any two lines of buildings. These medieval streets have no general direction, but just wander helplessly around until released from their suffering by the open fields, by an old-time market-place, or by some thoroughfare planned and carried out in modern times.

ON MARKET SQUARE IN BRAUNSCHWEIG (BRUNSWICK)

"Buttressed by hoary history, golden with romance, rich in beautiful architecture and in the wisdom to cherish it, what wonder that Hildesheim's jewel, the Knochenhauer Amthaus, Braunschweig's Burg, Wernigerode's Rathaus, are the traveler's familiar friends!" (see text, page 122).

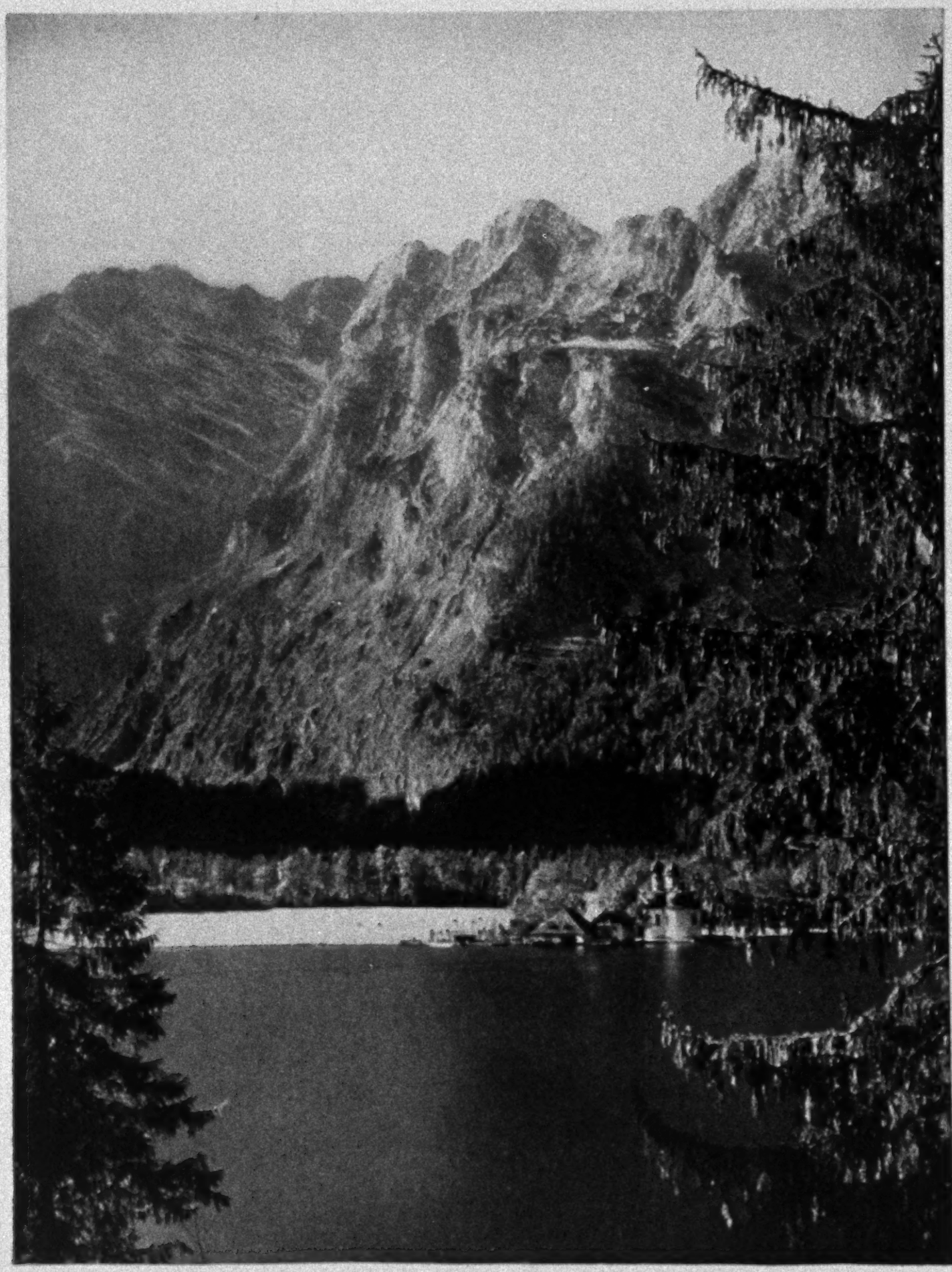
distant, curving streets and dusky corners where one may readily walk hand-in-hand with the sixteenth century. Tall-timbered houses rise, one story overstepping another, until scarcely a strip of blue shows between the gables. Small casement windows open in close lines above a frieze delicately carved, gorgeously painted; allegorical figures, imps, monsters, angels, and hobgoblins creep, crawl, or pose wherever they may find foothold. Look down from your window. In the square the bronze lion will recall that Henry the Lion whose town this was, and with the name more stirring history than one can well compress into a morning.

And after Hildesheim and Braunschweig there are Goslar and Halberstadt, Osterode, Quedlinburg, Wernigerode—all close neighbors, all many-gabled, to dispute Münster's claims. After these Harz towns, far to the southward, the unforgettable glories of Nürnberg and Rotenburg, of Wurzburg, Regensburg, and Ulm. Now, indeed, we feel that we have been overbold; in friendliness we have been unfriendly.



SMALL TOWN LIFE IN GERMANY

The small towns of Germany have their similarities, but they possess numerous peculiarities as well. For instance, the butchers who had the inspiration to advertise their slaughter-house by a recumbent statue of a German cousin of the Texas longhorn are not to be found everywhere. The clean appearance of the street is characteristic of German towns as well as of German cities.

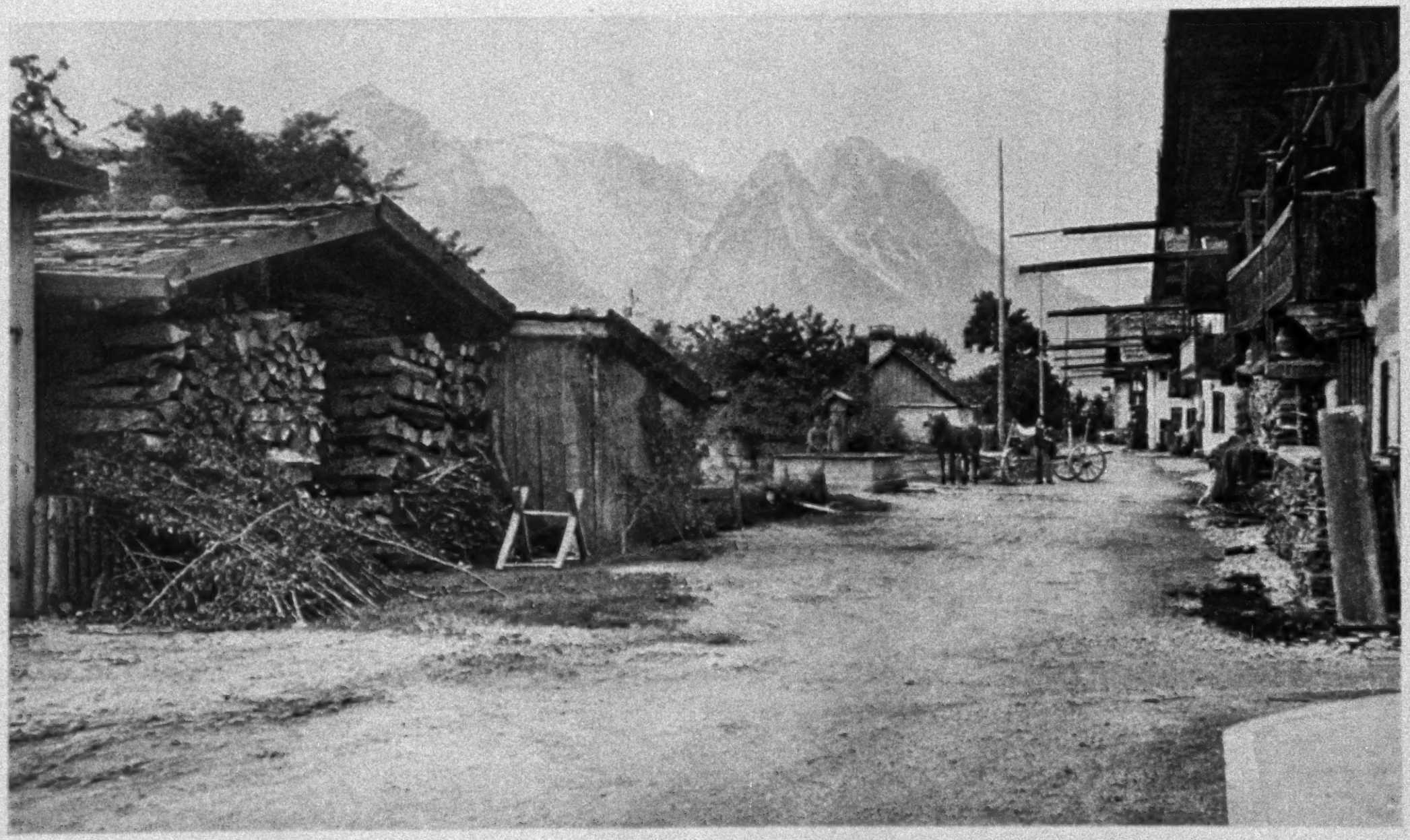


IN THE BAVARIAN MOUNTAINS

The Bavarian Mountains, especially those lying immediately south of Munich, are used by the youth of Germany as a training grounds for Swiss Alpine climbing. These rock masses present most of the problems that meet the sportsman on a larger scale in the higher Alps, and a season's work among them is a good preparation for a Mont Blanc diploma.

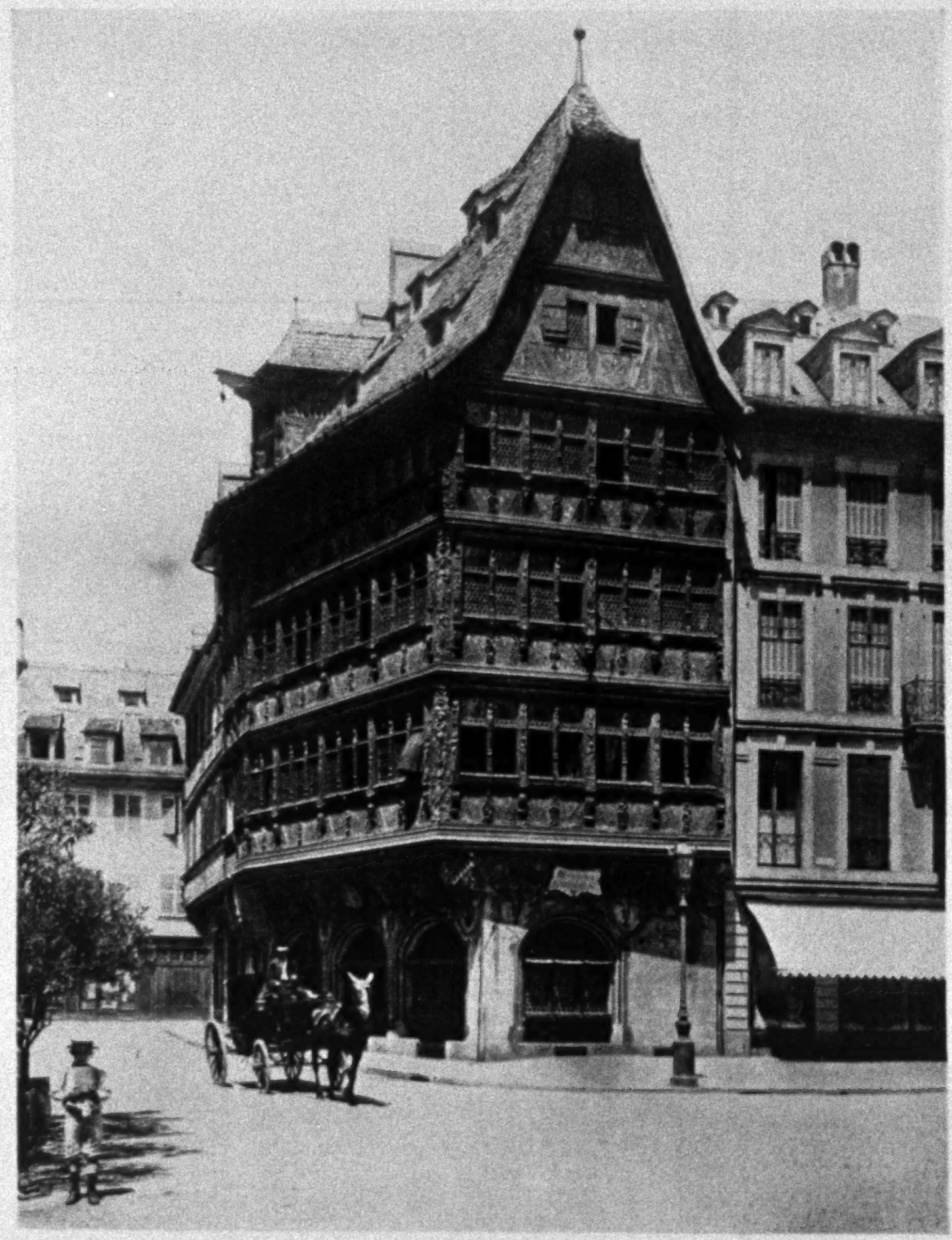
OBERSTDORF, NEAR THE LAKE OF CONSTANCE, BAVARIA

Bavarian villages are a source of continual delight to the traveler in that country. They break upon the vision from the mountain brow, from an open interval on the forest path, and from around the curve on the broad country road, with their red and green gabled roofs and white-washed walls, and they are always so well placed amid the natural beauties of the landscape that the enveloping country seems to have been built around them and for them.



GARMISCH VILLAGE: BAVARIA, GERMANY

Farmers' homes in Germany are crowded closely together in village clusters. The land of each peasant proprietor lies somewhere in the surrounding country beyond the village, but seldom near at hand; in fact, "the farm" may consist of several plots of ground lying in as many different directions and each having as little relationship as possible to the convenience of the owner. The farm plots are of all conceivable shapes. A potato patch may be 20 feet wide and a quarter of a mile long, or it may be a squat, multi-sided figure cut out of the midst of the open field. These fanciful farms are the outcome of a sense of justice of earlier generations of farmers, who sought fairly to apportion among themselves the good and the poor lands.



ONE OF GERMANY'S WORLD-FAMOUS WINE SALOONS, THE KAMMERZELL'SCHE HAUS: STRASSBURG

There is one at Leipzig, where Faust sat at table with the Devil and three jolly students; another in Göttingen, whose cellars are stored with wines generations old; a third in the town-hall of Bremen, whose vaults contain the most expensive wines to be found in the world; and the Kammerzell'sche Haus in Strassburg is the fourth. It is one of Germany's proudest examples of half-timber architecture. Within its walls one sips his wine and eats his game in the atmosphere of the Middle Ages.

Photo by Emil P. Albrecht

A TALL, OLD TIMBER STRUCTURE, WITH AS MANY STORIES IN ITS HIGH-PEAKED ROOF AS THERE ARE BELOW IT; HILDESHEIM

"And Hildesheim is assuredly a jewel of a town, well calculated to make one forget another's charms. Who shall truly picture her delightfulness; her winding, narrow streets; her tall-timbered houses; her market-place, walled by stately dwellings; her open places, ringed by bewildering gables; her tall, grave churches and grim old towers" (see text, page 119).

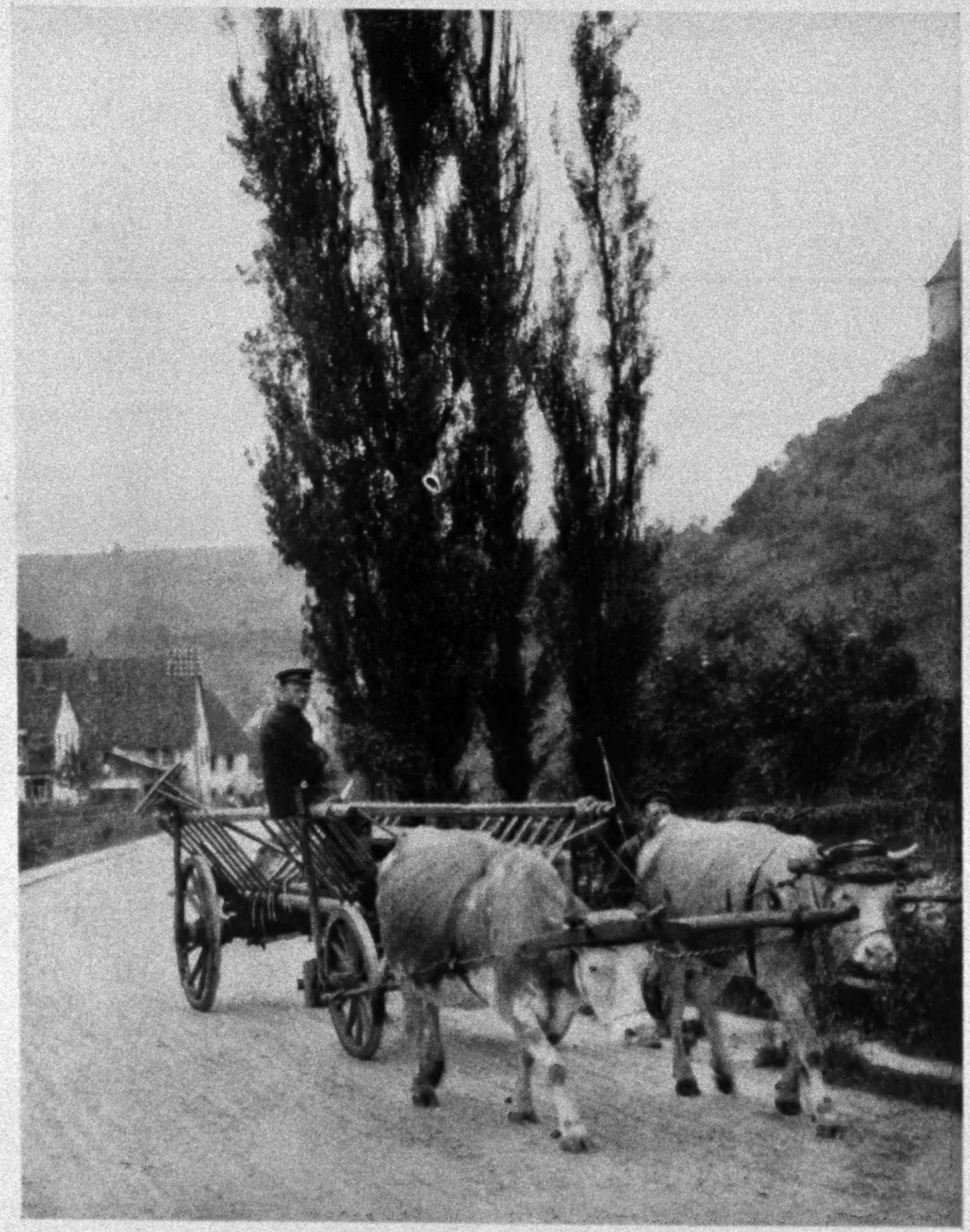


Photo by Emil P. Albrecht

NEAR SCHWABISCH HALL: THE ROAD THROUGH STEINBACH, KOMBURG

The northern part of Germany is a uniform plain. This comprises about three-sevenths of the Empire's total area. The central and southern sections consist of numerous rolling plateaus and fertile valleys, broken by low lying mountains, some in chains and some in isolated groups, but none so situated as seriously to interfere with road or railroad communication. The Bavarian Alps, the Black Forest region, and the Vosges are among the most picturesque sections of the Empire.

Photo by Emil P. Albrecht

A QUAINT OLD FOUNTAIN IN BRAUNSCHWEIG: GERMANY

Till Eulenspiegel, a famous German jester, who lived in the fourteenth century and whose jokes are now famous in every language, lived here as a boy. He is reputed to have worked in the bakeshop at No. 11, Backerklint. While working there he made little owls and monkeys out of gingerbread and gave them to the children. The building is still occupied as a bakery, and does a thriving business in gingerbread monkeys and owls. His humor and his love of children are commemorated by the fountain opposite the bakeshop. Note the owls and monkeys sitting around the fountain as if to drink in his wisdom and his fun. Nowhere in Germany is finer carving to be found than on the old houses in Braunschweig (Brunswick).

Photo by Emil P. Albrecht

ALL AROUND THE CITY OF QUEDLINBURG ARE VAST NURSERIES AND SEED FARMS

The line of the old walls is now a beautiful park, with tastefully arranged flower-beds running down to the river's edge

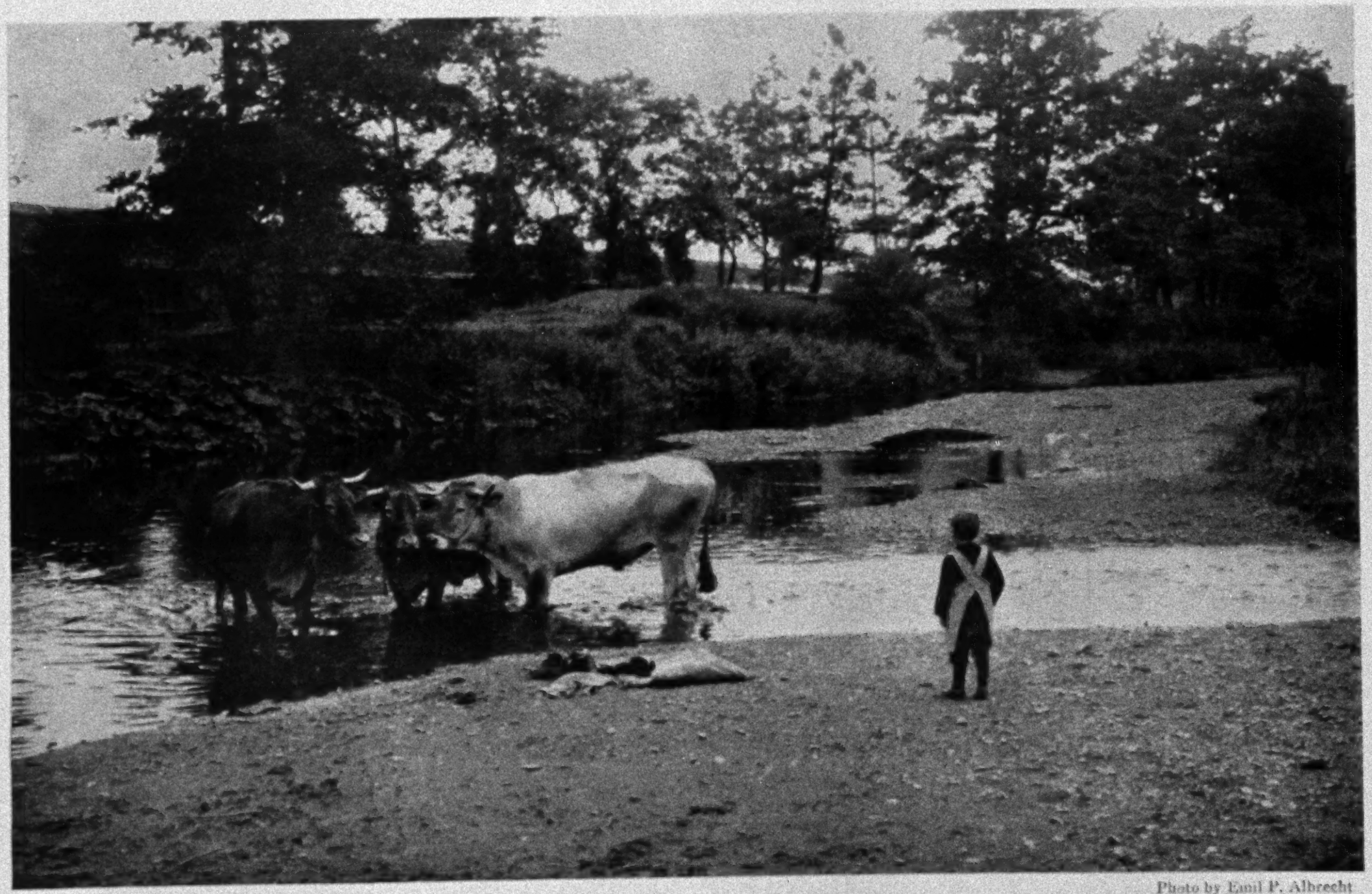


Photo by Emil P. Albrecht

A NOONTIME REST: QUEDLINBURG, GERMANY

Beautiful, sleek oxen are used on the farms, and after a hot morning's work are allowed to wander into the cool shadows of the trees, where they fall over the little clear stream

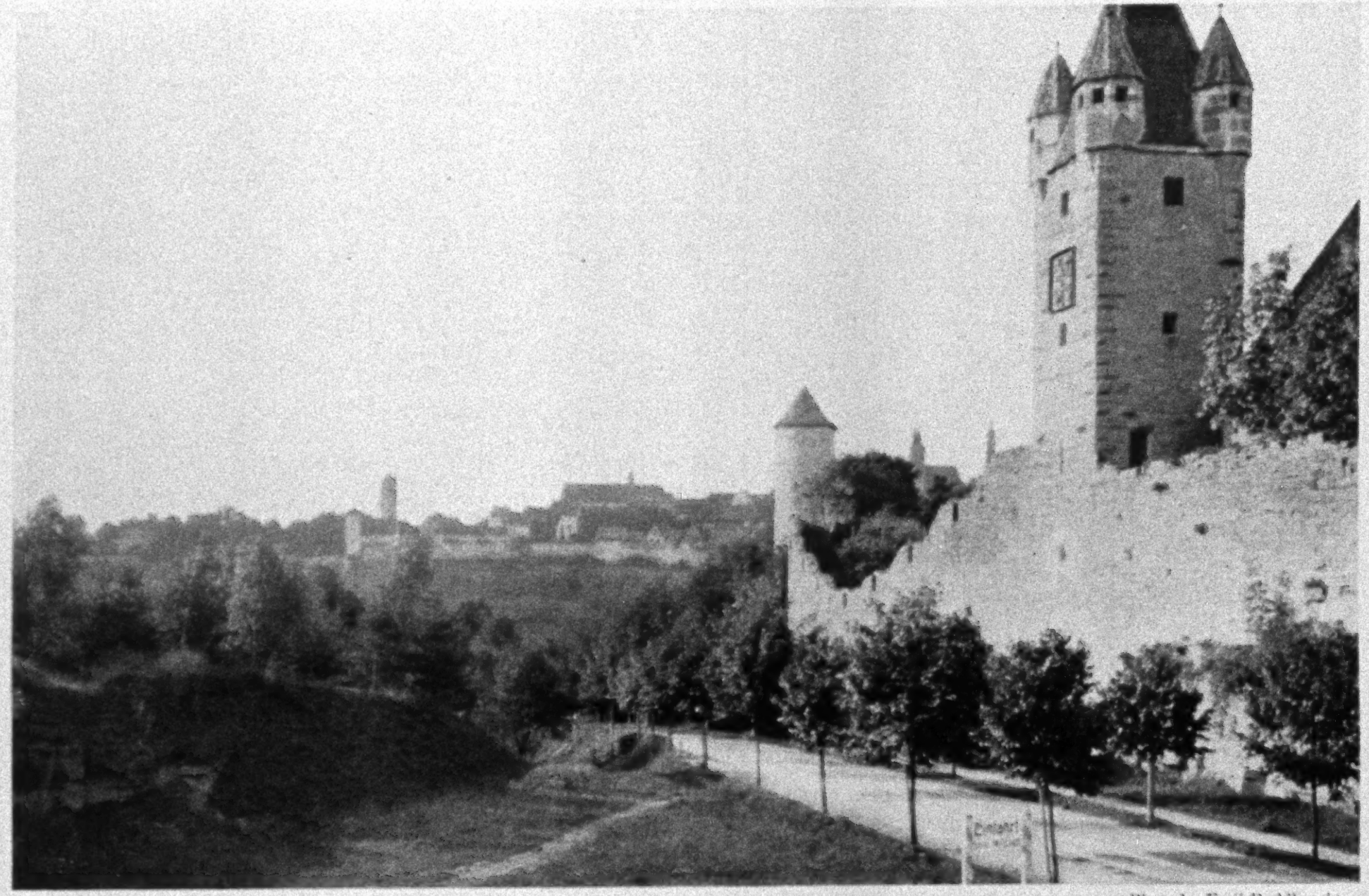


Photo by Emil P. Albrecht

ONE OF ROTHENBURG'S MOST BEAUTIFUL TOWERS: BAVARIA, GERMANY

Medæval Germany was a region of walled towns, and the inter-city wars of that period followed one another in almost unbroken regularity. Today the walled town has all but disappeared from the Empire. Expanding populations have grown past the walls, and they in turn have been leveled and converted into parks and promenades.

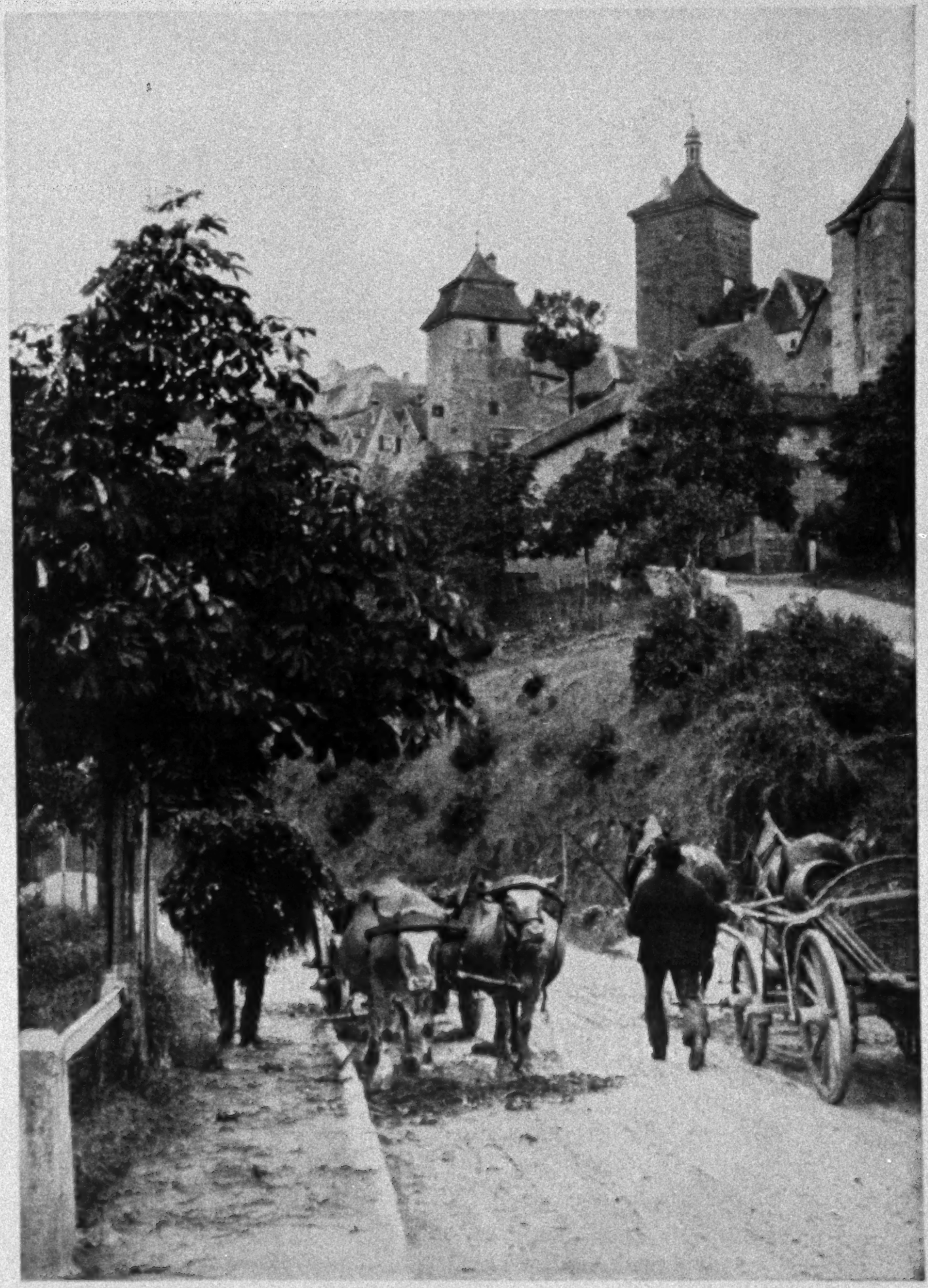


Photo by Emil P. Albrecht

THREE METHODS OF TRANSPORTATION IN ROTHENBURG: HORSES AND WAGON, OXEN AND CART, AND A MAN'S BACK

It is a long, steep climb up into Rothenburg, no matter which path one chooses, and he meets many of these hay-laden men upon the way

Photo by Emil P. Albrecht

OUTSIDE ONE OF THE GATES OF ROTHENBURG

The charming oriel of the house on the right is a favorite subject of the many artists who visit the picturesque old town

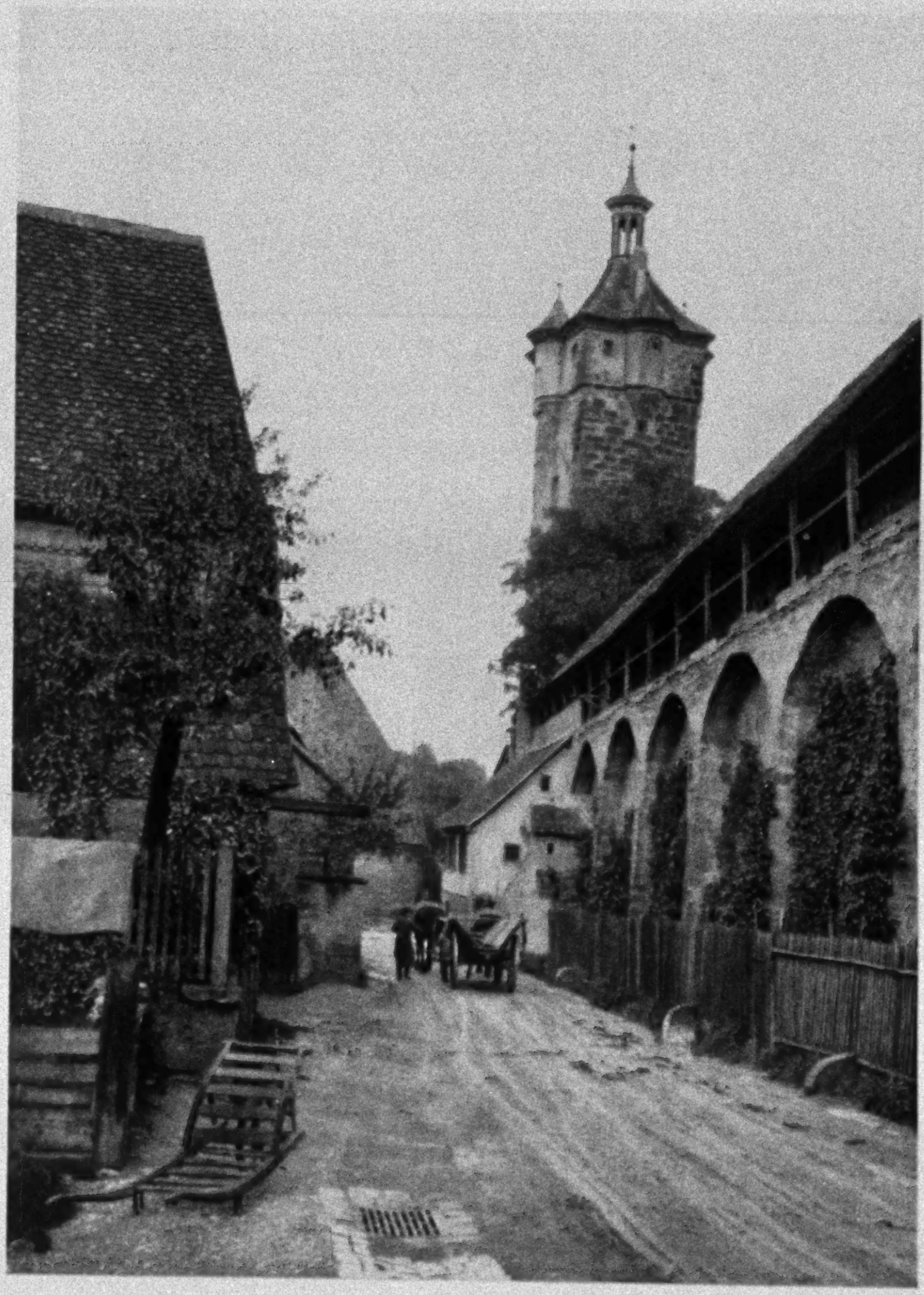
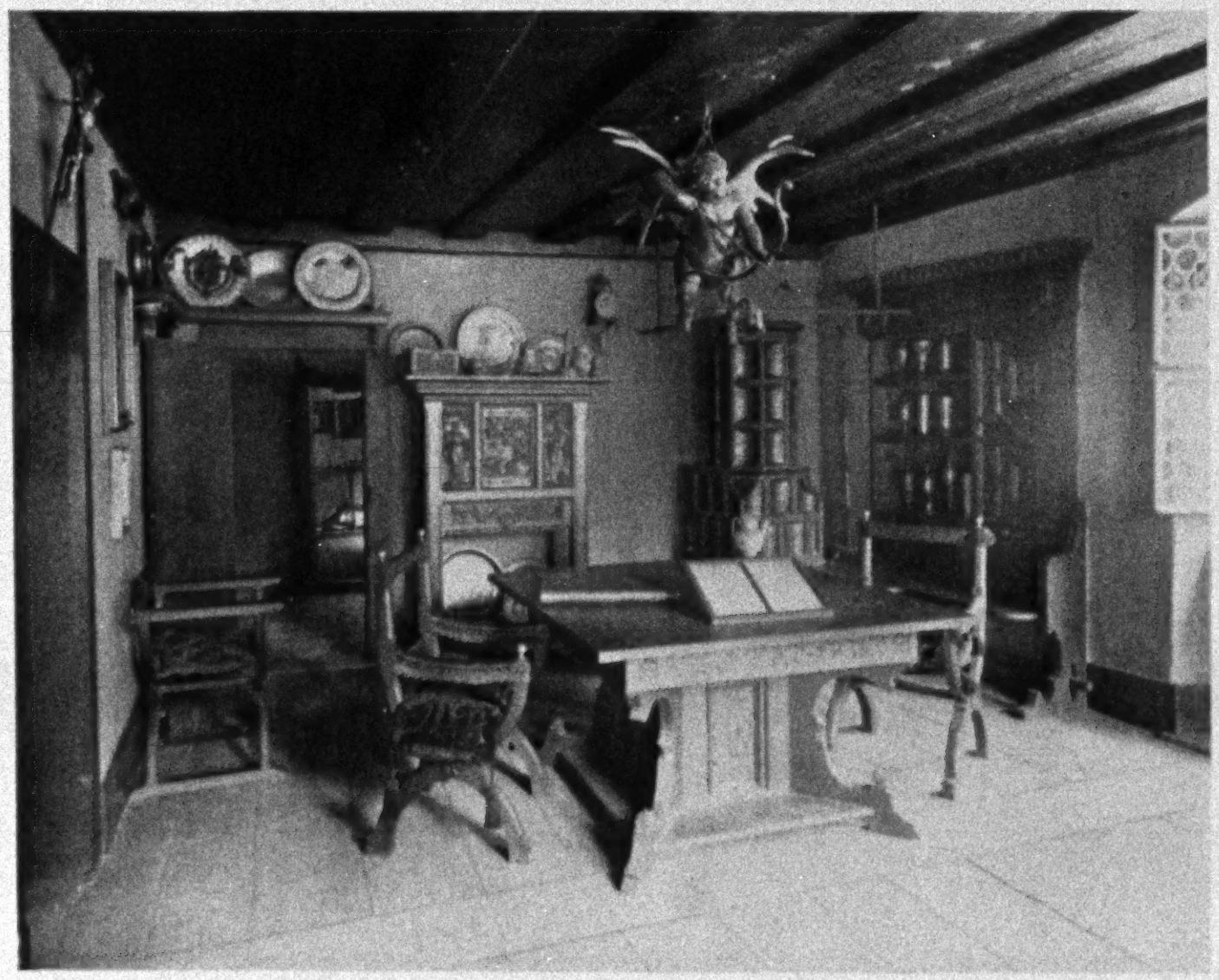


Photo by Emil P. Albrecht

THE LOFTY WALL OF ROTHENBURG SEEN FROM THE INSIDE

Note the covered walk with balustrade surmounting the wall. Once a place for defense, the gallery is now given over to the rope-makers. From it one has charming views over the town and the surrounding country. Upon it one can pass around at least two-thirds of the town. It is reached by steps at the various gates.



A ROOM IN ALBRECHT DÜRER'S HOME IN NUREMBERG, GERMANY

Dürer was one of Germany's greatest painters and engravers, and his artistic career stands out among those of his fellow great among the Germans by being marked with universal honor and recognition while still in his prime. His friendships reached to every land where Western habits of thought reached.

THE GABLED CITIES OF THE HARZ

Better known are all these cities to the average tourist than Münster. Either they lie upon traveled highroads or they make definite demand for attention, or they are set in a loveliness that will not be ignored. All about the green Harz Mountains lie these quaint old gabled cities, looking up to hills that afford such pleasant summer journeyings. Buttressed by hoary history, golden with romance, rich in beautiful architecture and in the wisdom to cherish it, readily reachable from Hannover or Berlin, what wonder that Hildesheim's jewel, the Knochenhauer Amthaus (p. 122), Braunschweig's Burg, Wernigerode's Rathaus, are the traveler's familiar friends!

More familiar still are Nuremberg's stately gables, the scarcely less pretentious ones of her neighbors. Rothenburg has become a show place, a museum; Nordlingen has been discovered; even Dinkelsbuhl has its visitors, and its gables appear upon post-cards. I should have known better than to give the title to Münster; Münster, so off the beaten trail, so unbefriended by nature, so slighted by romance, so inconspicuous in history; Münster, which rarely sees the foreign traveler, never the tourist, and is profoundly indifferent about it.

Yet let her keep the title. Have we not already remembered her gray houses through a score of years? Even in Meinhardshof at Braunschweig, by the Tauber beneath Rothenburg's walls, on Wurzburg's stately bridge, in Nuremberg's market-place, we have recalled right pleasantly her dim, shadowy arches and tall gables. Yes, let her keep the name.

A FISH AUCTION IN NORTHERN FRANCE: FISHING BOATS NOW SWEEP THE SEAS FOR MINES INSTEAD OF SEINING IT FOR FISH

EUROPE'S ENDANGERED FISH SUPPLY: THE WAR AND THE NORTH SEA FISHERIES

WITH its war zones and counter war zones, its mined areas, its hostile fleets, and its heavily defended shores, the North Sea, in a few months, has been transformed from one of the richest food-producing areas in Christendom into a region upon whose mastery may depend the starvation of one or the other of two of the mightiest nations of the earth.

In times of peace no other like area in all the seas ever has given to humanity such rich supplies of food as this narrow strait separating Albion from the continent of Europe. More than in any other known region of the oceans, the food fishes of the marine world seem to love to congregate there, and to feel that it is home to them in spite of an age-long attack upon them by the greatest of all creatures of prey—man.

MILLIONS OF TONS OF FISH

Step by step every new idea of art and science has been brought to the aid of the fisherfolk of the North Sea, and by the same step-by-step process the annual drain on its resources has climbed higher and higher, until finally, during the year previous to the present war, it amounted to a million and a quarter tons of fish. Counting two tons to the truck-load and allowing 30 feet to the truck, this would make a procession of fish trucks reaching across the United States from New York to San Francisco via New Orleans.

Yet almost as rapidly as the demands of the world have risen, the supply has increased, and, except for a too heavy concentration of fishing forces on some individual bank now and then, there is no evidence of any serious depletion of the stock.

The lesson of the present war to the inhabitants of Neptune's kingdom is that it is an ill wind which blows nobody good. But yesterday thousands of steam trawlers pursued their way up and down the fishing grounds of the North Sea, gathering in with their vast nets untold millions of fish. Other thousands of drifters dropped down over the fishing banks and vied with the trawlers in the magnitude of their catch. Other thousands, and even tens of thousands, of boats equipped with a myriad of baited hooks aided in collecting the tremendous tax levied by the human appetite upon the sea.

Today a hundred thousand Englishmen who manned the steam trawl, the drifter, and the sailing boat; tens of thousands of Germans who vied with them in their work; Belgians, the French, the Dutch, the Danes, and the Scandinavians, who also helped exploit the North Sea fisheries—all of these are largely out of jobs. Fishing boats now sweep the sea for mines instead of seining it for fish.

THE SERIOUSNESS OF THE SHORTAGE

We in America, where fish forms such a minor part of our daily diet, and where so many of the fish that we eat are grown in our rivers and bays, under a great American-originated system of fish culture, find it hard to realize how serious in their proportions and how far-reaching in their consequences are the results of the practical closing down of the fisheries of the North Sea.

Europe has depended very much on these fisheries for fish supplies. More than half of all the fish produced on all the fishing grounds operated by Europeans are caught within the limited territory that constitutes the North Sea fishing grounds. How much they are depended upon is shown by the fact that Great Britain annually absorbs 500,000 tons of North Sea fish; that means 22 pounds per capita. And while this is small in proportion to her per capita meat consumption of 119 pounds, yet it is that margin which represents the difference between a bounteous plenty and positive hunger unless other foods can be secured to take its place.

The same condition applies to Germany. Not only has that country heretofore used all of its own catch, but has annually imported more than a million and a quarter barrels from other countries around the North Sea. The United Kingdom and Germany are the two greatest meat-eating nations of the six leading ones now at war, Germany's per capita consumption being 113 pounds. An investigation reveals the fact that as meat becomes less and less important in a nation's dietary, fish becomes more and more important. France has a per capita consumption of 80 pounds of meat, Belgium 70, Austria-Hungary 64, and Russia 50.

FEW FISH IN THE BALTIC

Germany cannot look to the Baltic for any large supply of fish to replace her former supplies from the North Sea, for the waters of that sea are poor producing grounds. The total annual yield there is only about a tenth as great as that of the North Sea, and Germany's share of this is, in normal times, very small.

Great Britain's North Sea fisheries represent nearly two-thirds of the total catch there, and are more than eight times as large as those of Germany.

In the North Sea three-fifths of the total catch are herring; haddock takes second place, constituting 11 per cent of the total; cod comes third, with 8.5 per cent, and the plaice fourth, with 4.3 per cent of the total catch. In the matter of values the ratio is somewhat different from that of weights. Constituting 62.7 per cent of the weight of the season's catch, the herring accounts for only 45.4 per cent of its value.

The vast proportion of the fish consumed in Europe is salt fish. The fresh fish go to the tables of the rich, while the herring and other salted varieties are consumed principally by the masses. The result is that when the pinch in the fish supply began to come it visited the homes of the well-to-do first. All of the countries at war probably have enough salt fish in their warehouses to tide over a considerable period, but if the war keeps up this reserve must disappear.

Not only do the nations at war feel the pinch of the fish shortage caused by the war, but neutral nations as well. Holland feels it sorely from a production

COAST FISHERMEN IN NORTHERN FRANCE

Since the European war has reached its present bitter stage most of the fishing done in the North Sea is by small boats, close to shore. The fish they catch are the ones usually sold fresh instead of being salted.

A NET-MAKER IN BRITTANY

"With its war zones and counter war zones, its mined areas, its hostile fleets, and its heavily defended shores, the North Sea, in a few months, has been transformed from one of the richest food-producing areas in Christendom into a region upon whose mastery may depend the starvation of one or the other of two of the mightiest nations of the earth" (see text, page 141).

Photo from Dr. Hugh M. Smith

A MILLION COD HEADS READY TO BE MADE INTO COMMERCIAL FERTILIZER

"Step by step every new idea of art and science has been brought to the aid of the fisherfolk of the North Sea, and by the same step-by-step process the annual drain on its resources has climbed higher and higher, until finally, during the year previous to the present war, it amounted to a million and a quarter tons of fish. Counting two tons to the truck-load and allowing 30 feet to the truck, this would make a procession of fish trucks reaching across the United States from New York to San Francisco via New Orleans. Yet almost as rapidly as the demands of the world have risen, the supply has increased, and, except for a too heavy concentration of fishing forces on some individual bank now and then, there is no evidence of any serious depletion of the stock" (see text, page 141).

standpoint, as do also Sweden, Norway, and Denmark. On the other hand, it hits Switzerland more from a consumption standpoint. That country normally buys nearly a million dollars' worth of fish from the countries that border the North Sea.

Many regions around the North Sea live almost entirely by their fishing industry. The Orkneys and the Shetland Islands have almost no other activities. Lerwick, the principal town of these islands, in winter has a population of 4,000. In summer this grows to 19,000 and everybody is busy with the fisheries. Where the little Scotch town of Buckie possessed three steam fishing boats in 1910, it possessed 150 in 1914. The port of Fraserburg annually handles 100,000 tons of fish, and Aberdeen has increased her fishing business sixtyfold in 14 years.

THE WORLD'S FISHING CAPITAL

In Great Britain the fishing industry is centralized in a few large ports; in France it is scattered among a great many small ports. Grimsby is the fishing capital of the world, with an annual output of perhaps 300,000 tons of fish. There one encounters a more feverish excitement than anything he may witness in the great stockyards district of Chicago. A hundred trawlers, their great bins full to overflowing with their latest catch, draw up to the fish dock in the order of their arrival in port, and a swarming army of fishermen, porters, criers, dockers, and packers set up an uproar which

Photo by A. B. Wilse

COD FISHERMEN AND THEIR CATCH

In the production of eggs the cod is one of the most prolific of all species of fish. It is estimated that the turbot spawns 9,000,000 eggs a season, the cod 6,000,000, the mackerel 700,000, and the herring 50,000. The young cod is about an inch in length at the end of spring and has to reach two years of age before being fit to market. They do not reach maturity until the end of their third year.

makes one think that some inferno has found an abiding place there.

Over 600 steam trawlers operate from this port in times of peace. A special harbor has been built for the fish trade. There are two entrances to it, an outer basin containing 12 acres, an inner basin of 15 acres, and two dry-docks. The market, built on the quay, is a vast shed nearly a mile and a half long and two stories high. The building is equipped with numerous unloading cranes and endless-chain elevators. On the farther side of the shed are the railway lines, and it is not an unusual sight to see four trains being loaded at a time.

There is always a race for position between the hundred or more trawlers that ascend the Humber as soon as the tidal gates are opened in the morning, for at Grimsby the parallel of "first come, first served" is "first at the dock, first unloaded"; and time is too precious in the fishing season to stay away from the fishing banks a minute longer than necessary.

BUSY DAYS IN GRIMSBY

The sale begins at the northern end of the shed, and never did a British admiral of the Royal Navy maneuver more dexterously for position than do the captains of Grimsby trawlers. A veritable scrimmage of hurrying vessels, every now and then bumping into one another by bow or beam, makes the onlooker wonder how serious collisions are averted; and yet there are few of these to record.

The trawlers tie up, bows to the quay, in closely packed ranks. Unloading begins at once. Great baskets are hoisted from the holds, laden with fish. Other baskets go down to take their places, and

Photo from Dr. Hugh M. Smith

A HERRING AUCTION IN GRIMSBY, ENGLAND

"We in America, where fish forms such a minor part of our daily diet, and where so many of the fish that we eat are grown in our rivers and bays, under a great American-originated system of fish culture, find it hard to realize how serious in their proportions and how far-reaching in their consequences are the results of the practical closing down of the fisheries of the North Sea" (see text, page 142).

so the endless chain of outgoing baskets laden to the rim and incoming empties keeps passing until the trawler's load is on the dock.

One sees the cod laid out in one, two, three, and four dozen lots. Here are the big halibut, with their white bellies turned up, still quivering with the life that has not entirely gone out of them. The smaller species, such as the whiting, plaice, and gurnards, are carefully washed and arranged in wooden boxes.

At 8 o'clock the auction begins. A big auctioneer bawls out the name of the fish he is offering for sale; a young laddie, scarcely in his teens, vigorously rings a hand-bell with a mastery that makes its clanging melodious, and the buyers approach. From early morning to late afternoon the sale continues. An army of jostling workmen labor as if their lives depended upon it—scrubbing, washing, packing fish, and loading the numerous trains that soon are hastening to all parts of Great Britain with their fishy freight Sometimes men armed with long, forbidding-looking knives run along the dock, plunge their great daggers into each cod, grab out the liver, and hasten on to the next pile as if there were no time but the living moment to finish the job.

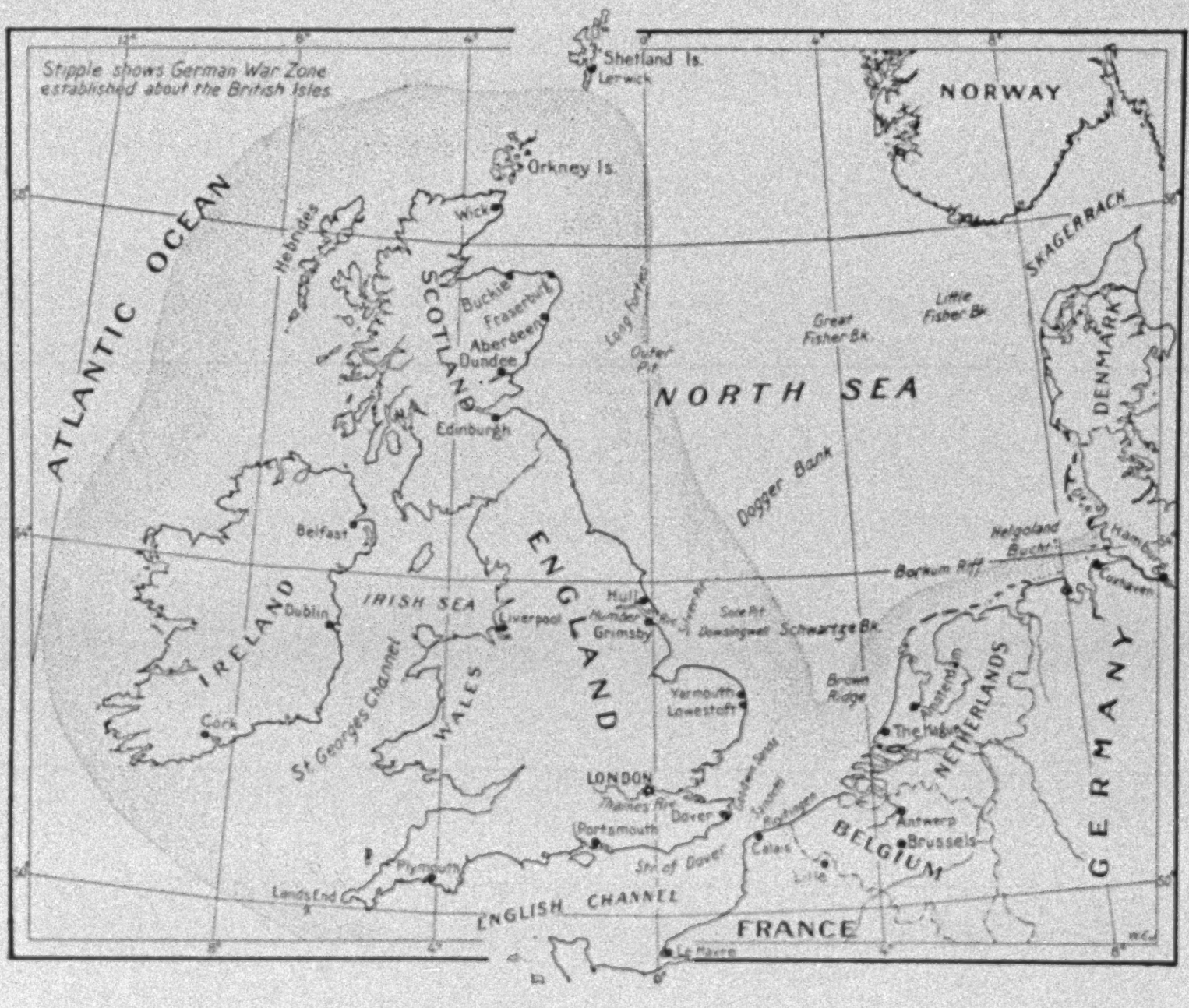
BACK TO THE FISHING BANKS

After a skipper's catch is sold he reverses his engines, backs out from the quay, goes to the ice dock, fills the hold of his vessel with ice, its bunkers with coal, and its larder with victuals, and hastens back to the fishing grounds; for there are too many fish on the banks awaiting his coming to permit of a picnic party ashore. Such functions are in order when the howling winter seas make trawling impossible.

For it can never be more important for a farmer to make hay while the sun shines than for the North Sea fisherman to keep busy while the sea is calm. The

THE PROMENADE OF A NORTH SEA RESORT: BORKUM, GERMANY

All along the North Sea from Ostend to the Danish coast there are seaside watering places where the European world has gone in times past to take the baths. Hard by are the fish wharves. These places have all been deserted. Mars rules today where Fashion held sway yesterday



MAP SHOWING THE FISHING BANKS OF THE NORTH SEA AND THE "WAR ZONE" ABOUT THE BRITISH ISLES

average English fisherman is responsible for a catch of nearly ten tons of fish a year, and its value is about $505.

The fish that come to Grimsby are mostly the food of the masses, for Grimsby is a port of trawlers. It is Lowestoft and Yarmouth that give to the epicure and the gourmet his supply of fish, for Lowestoft is the port of the graceful sailing vessel, with its lines of baited hooks, bringing in 12,000 tons of turbot, sole, and brill annually.

BILLINGSGATE FISH SALES

It is at Billingsgate that one encounters the world's greatest middleman's fish market. London devours over one and a half million pounds of fish every day in normal times—a quarter of a million tons a year that means. Eleven railroads bring about 550 tons a day and the remainder comes by water. Before being offered for sale, the fish at Billingsgate are inspected by a commission of the "Worshipful Company of Fishmongers," which holds letters patent granted it by King Edward I at the beginning of the thirteenth century. This ancient society represents, through the "North Sea Protective Association," more than fifty of the leading fishing companies of the United Kingdom.

Our great American fish culturist, Dr. Hugh M. Smith, in speaking of the herring industry, says: "A tale as stirring as any fiction could be based upon the part played by the sea-herring in the history of some of the principal countries. 'Its spawning and feeding grounds have determined the location of cities,' and in

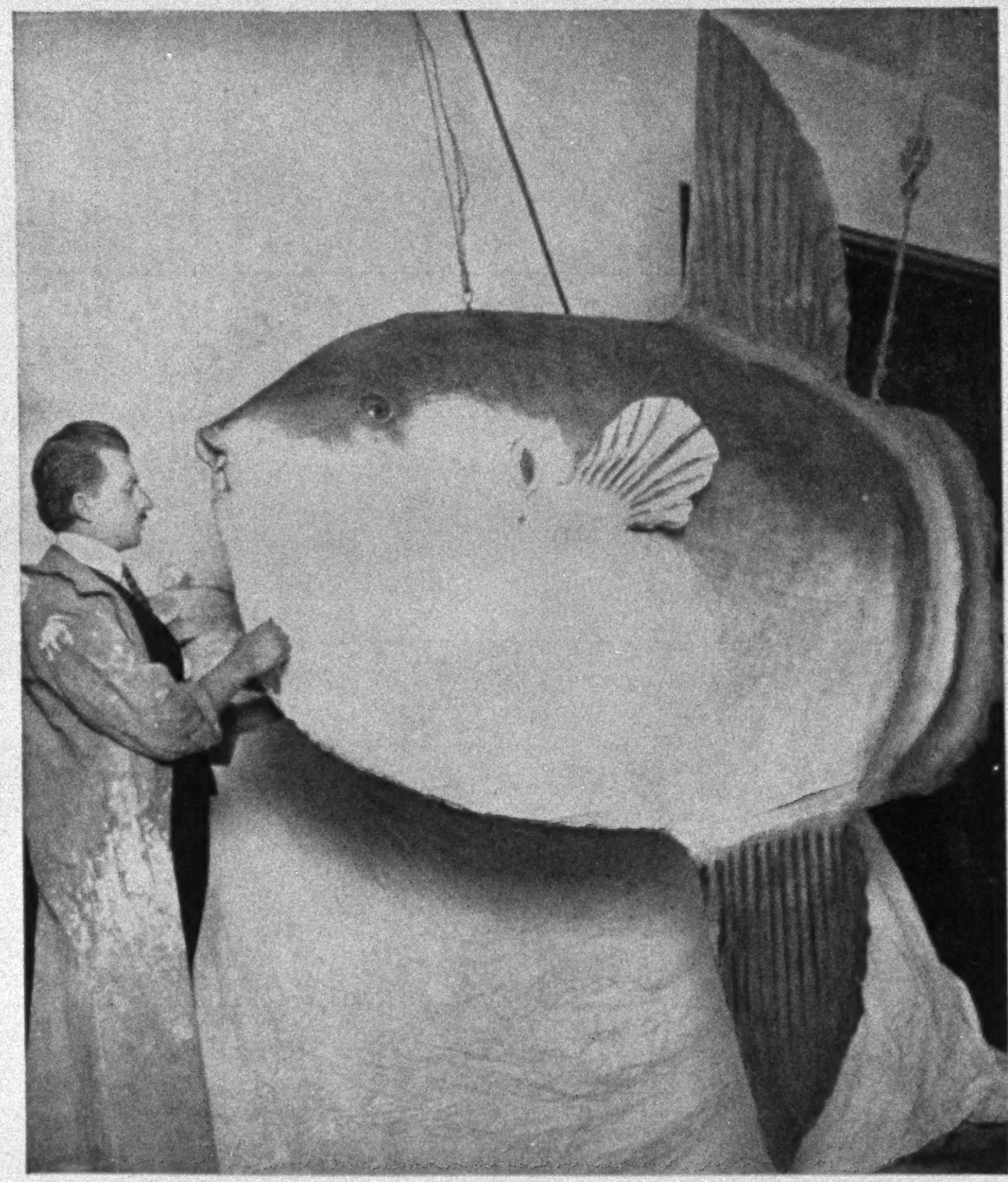


Photo by Walter L. Beasley

A GIANT SUNFISH CAPTURED IN THE PACIFIC OCEAN OFF THE CALIFORNIA COAST

This huge monster of the sea, measuring 11 feet from fin tip to fin tip and 10 feet from head to tail, weighed nearly a ton. It looks to be all head and no body, and this condition is believed to be due to the fact that the sunfish spends much of its time in very deep water, where most fishes develop huge heads and very spindling trunks. The big fish has comparatively a small mouth, and, to provide for the enormous stomach, consumes thousands of small fish and various other marine creatures. The great fins are 3 feet long, and when swimming the upper one protrudes high out of the water. It is thought that the specimen had attained great age, although its age cannot be estimated definitely. It may have been nearly a hundred years.

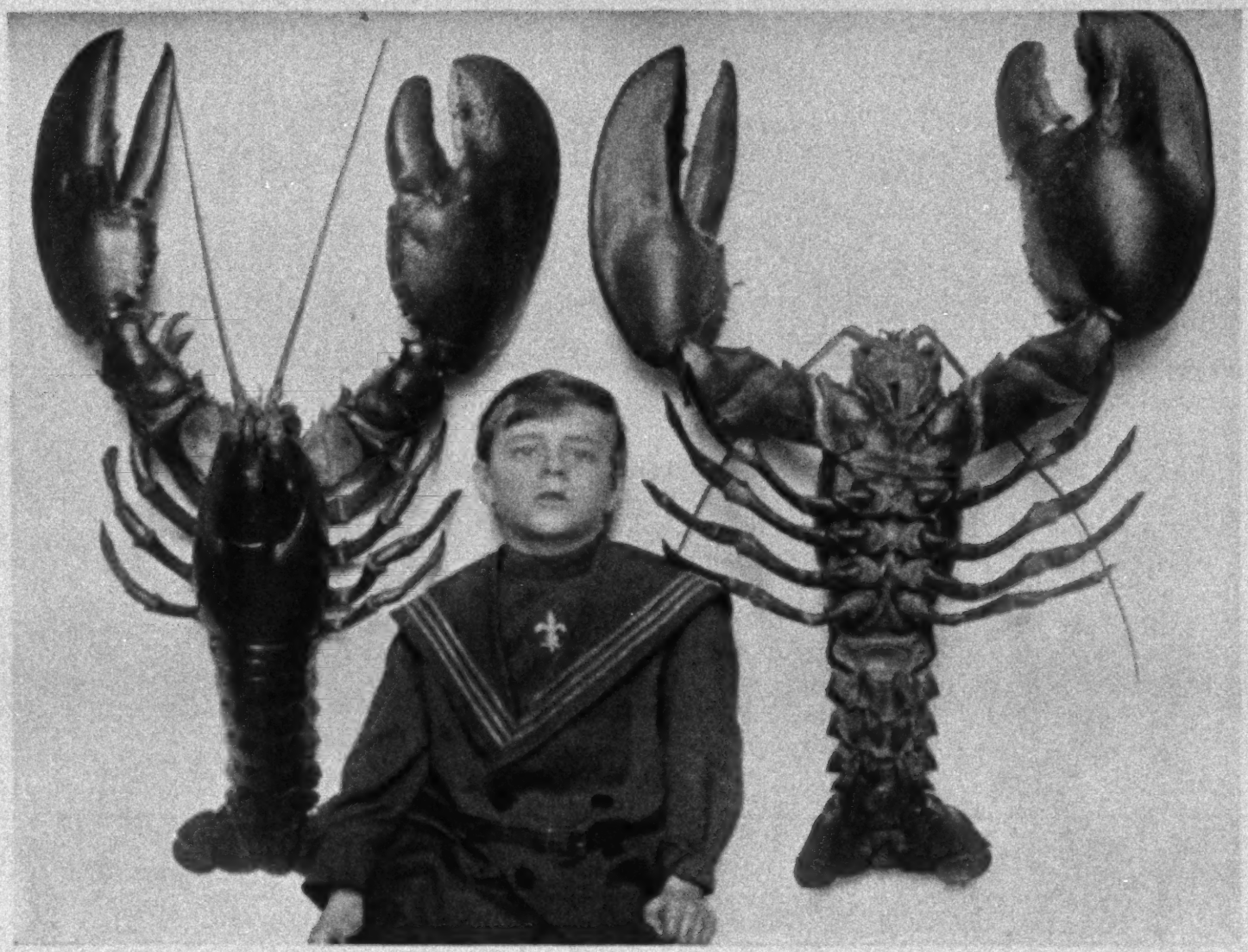


Photo by Walter L. Beasley

PROBABLY THE LARGEST LOBSTERS EVER CAUGHT

These two lobsters weighed, when caught, 28 and 34 pounds respectively. They were taken off the Highlands of New Jersey and are now mounted in the American Museum of Natural History. They utilized the enormous strength of their jaws and sawlike teeth in cutting holes and robbing the traps of all the bait, as their bodies were too large to get inside. Finally they were hauled up to the surface clinging to a trap. The giant specimen showed many scars, evidently from savage combats. The length of its life is estimated to have been fifty years, as the average age of a ten and twelve inch lobster is thirty years.

several instances the actual destiny of nations and the fate of their monarchs appear to have been involved in the herring fishery." (See NATIONAL GEOGRAPHIC MAGAZINE, pages 701-735, August, 1909.)

Dr. Smith reminds us that the foundations of Amsterdam were laid on herring bones, and that the prowess of the Dutch navy in the days when it triumphed over Britannia's banner was due directly to the herring fisheries and the herring fishers who manned it.

The annual catch of herring in the North Sea amounts to nearly 800,000 tons a year. That means the taking of some six billion herring alone from the comparatively small area of its fishing grounds. Yet in spite of this terrific toll they still come in undiminished number. In the matter of solid formations, unbroken phalanxes, and inexhaustible numbers, the herrings have no rival.

It is conservatively estimated that each mature female herring lays 20,000 eggs. Of these, 19,998 must never produce spawning females; for if any more of them did, speaking in averages, the North Sea itself would become a solid mass of herring in a comparatively few years. Huxley once observed that man is but one of a vast society of herring-catchers, of which a thousand enemies in the sea are the other members. If man took none at all, he would simply swell the dividends of the other members, and the herring would fare no better thereby.

NORTH SEA AREA LIMITED

The territory which constitutes the North Sea fishing grounds is strikingly limited in area compared to its importance. Its total area is less than 130,000 square miles, only a little larger than the State of New Mexico. The Dogger Bank is the center of it all—the Charing Cross of the sea, so to speak. To the south of Dogger Bank is Silver Pit, Sole Pit, Dowsingwell, Brown Ridge, Goowin Sands, the Sandetti, the Ruytingen, the Schwartzebank Borkum-Riff, and Helgoland-Bucht. To the north are Great Fisher Bank, Little Fisher Bank, the Long Forties, and Outer Pit—all famous fishing grounds.

Many conditions conspire to make the North Sea the favorite ground of food fishes. Through the submarine channel passing between the Shetland and the Faroe Islands it receives the warm waters of the Atlantic. A strong current of warm Mediterranean water sweeps out through the Strait of Gibraltar, curves around to the north, and finally, in part at least, joins the current that passes into the North Sea above the Shetland Islands. A current also comes down from the north, giving cooler surface water, and the brackish, slow-flowing German rivers bring down a wealth of food. Coming in from the channel end of the North Sea are other warm waters, and the two tidal waves, the one from the north and the other from the south, meet off the Dogger Bank and before the Thames, creating vast eddies and backwashes, which deposit immense quantities of fish food for food fishes.

A HOME-LOVING CREATURE

The strong influences of heredity upon fish make them stick to the habitats and habits of their progenitors with the utmost fidelity, and the development of the most highly organized fisheries industry in the world has not sufficed to change their homes or their habits. How closely they adhere to the habits of their ancestors is strikingly shown by a Canadian experiment. Salmon were accustomed to ascend the Nicola River to spawn, and it was noted that they always followed the one channel around a midstream island on their upward trip. A dam was built across this channel, while the other was left free. When the fish came to this point they would not take the other channel at all; they seemed to conclude that if they could not swim exactly where their ancestors had swam there was no use of their trying to go farther, and so they turned back.

It has been estimated that there are some 19,000 species of fish in the world, and some of the food fishes found in the North Sea are among the most prolific of them all. For instance, the turbot sometimes spawns 9,000,000 eggs a season, the codfish 6,000,000, the mackerel 700,000, the red gurnard 400,000, and the brill 200,000. The sole spawns 85,000 eggs and the herring as high as 50,000. Furthermore, petticoat government seems to rule in fish-land, for investigation shows that among the food fishes of the North Sea the females are in the vast majority. In the case of the conger they are 19 to 1, while in the case of herring there are three females for every male.

FISH CULTURE'S ADVANTAGES

The marine fisheries of Europe are vastly more important to European countries than those in United States waters ever can be to the American people. This is so in the first place because we have no fishing grounds in the Atlantic Ocean comparable to those of the North Sea in richness. It is so in the second place because the time when the per capita consumption of fish in the United States will equal that of Europe lies in that remote future when the population of North America shall equal that of Europe in density; but it is also true because no other nation on earth has had the foresight to stock its inland waters as the United States has done.

Last year the United States Bureau of Fisheries distributed more than three and a half billion baby fish in the inland waters of the country and half a billion eggs. This great work of artificial fish culture has been carried forward for years in such a way that our fish supply now comes in no mean proportion from our rivers, bays, and lakes. Europe has neglected fish culture: consequently, when her outlying waters are cut off from the fisherfolk, the supply is at an end.

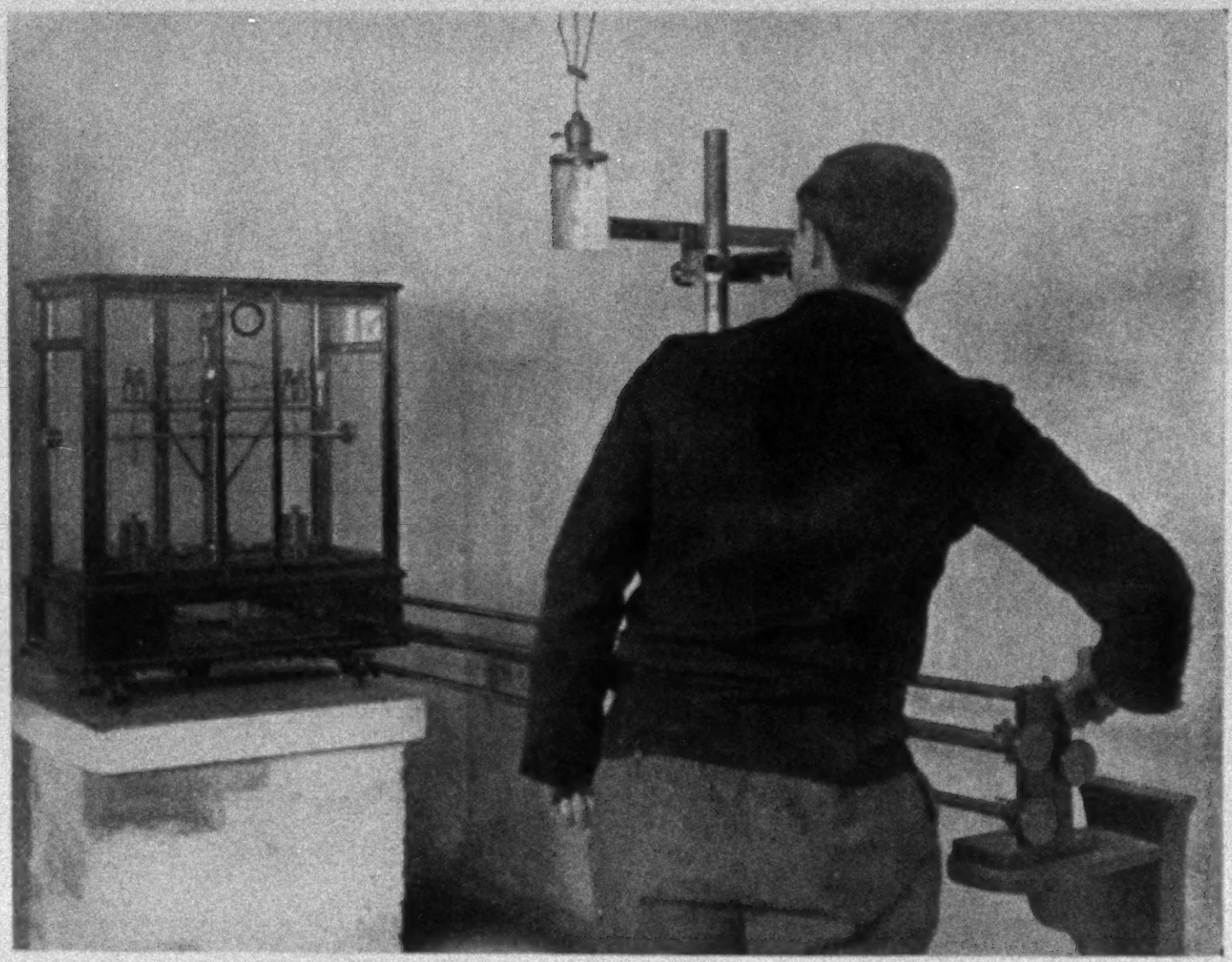


Photo from Bureau of Standards

A BALANCE SO DELICATE THAT THE EXPERT MUST OPERATE IT FROM A DISTANCE LEST THE HEAT OF HIS BODY SHOULD CAUSE A DISTURBANCE

The series of control rods and the telescope for reading the scale of this ingenious kilogram balance is also shown. The balance stands on a pedestal independent of the building, whereby freedom from vibration is secured.

A WONDERLAND OF SCIENCE

STANDING on one of the many high hills that fringe the Nation's Capital is a group of buildings that house one of the greatest aggregations of wonder workers in the New World. In their enchanted chambers truth makes fiction seem tame and commonplace; men make fairies appear weak, insipid, and impotent as doers of strange things.

Entering there, one may see a grain of sand become a mountain, an inch become a mile, an unappreciable zephyr become a howling storm, the footfall of a fly the thundering tread of a draft-horse upon a threshing floor, the heat of a candle a roaring furnace, the unperceived warmth of a star a cheering fireside, and the pressure of a finger the force of a thousand giants in one.

These enchanted chambers are the creation of the United States Bureau of Standards, which not only stands between the American people and the short weight and false measure, but also is laboring day in and day out to promote all branches of science. Some philosopher has recently declared that the science of tomorrow will have to be largely based upon investigations that carry the investigator beyond the sixth decimal place; in other words, the truths upon which our scientists will base tomorrow's progress

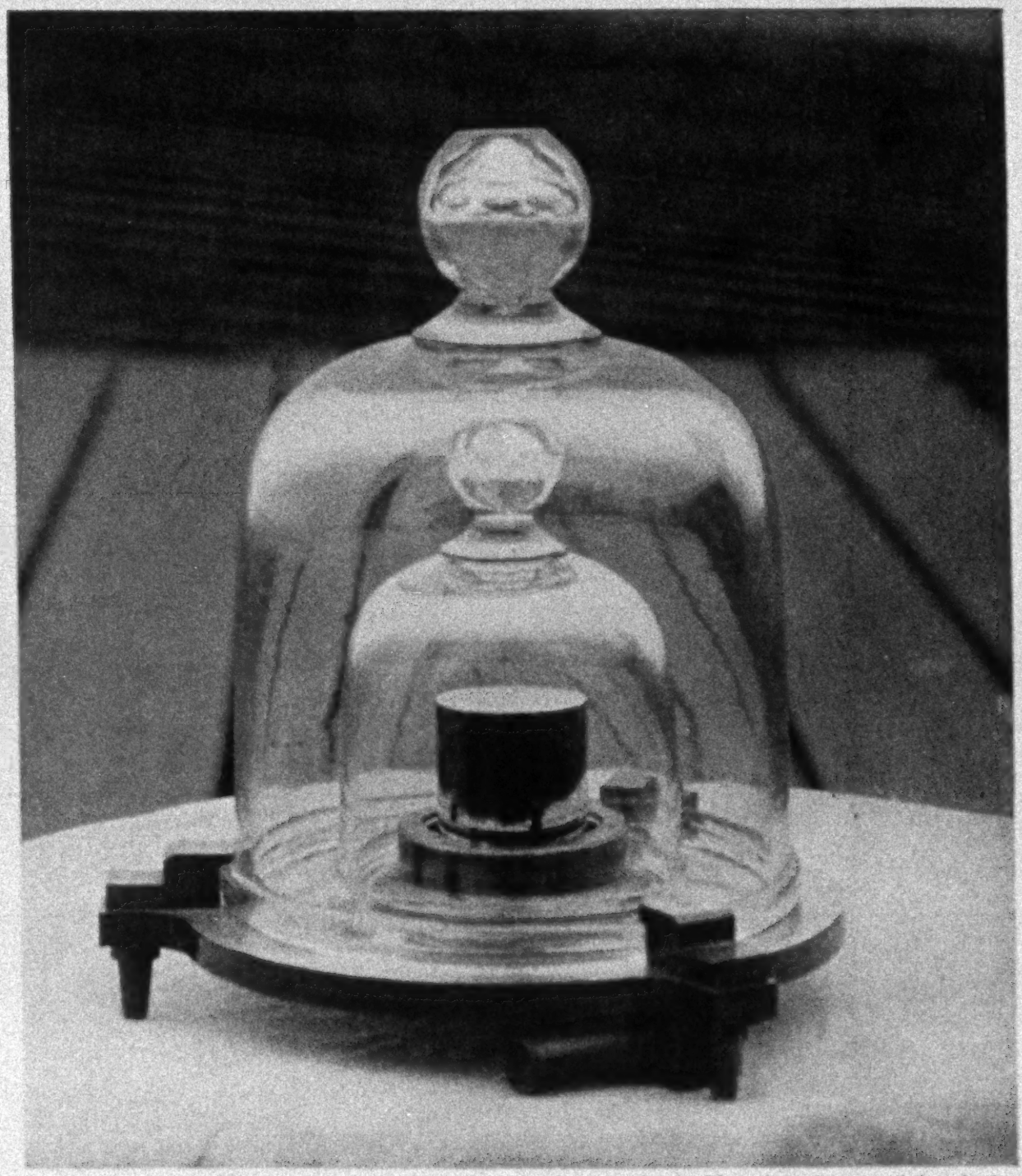


Photo from Bureau of Standards

THE STANDARD KILOGRAM FROM WHICH ARE DERIVED ALL OTHER WEIGHTS, SUCH AS THE POUND TROY AND AVOIRDUPOIS

The standard of mass, which is popularly called weight, is the kilogram. The one shown here is made of platinum-iridium and is a copy of the original kilogram, which is preserved near Paris, France. This copy is one of a number made and presented by France to the different governments of the world, and is No. 4 of the series. It is always kept under the double glass covers shown above, and is used only to check the working standards.

in the adaptation of scientific fact to human need lie beyond a millionth of an inch, beyond the millionth part of an ounce, beyond the millionth part of a degree of temperature.

Just as James Watt could not make a steam-engine until men were able to take measurements so exact that a cylinder and piston could be built which were steam-tight and yet allowed free play, so the perfect automobile of today had to wait until men could measure the five-thousandth part of an inch, and the perfect ship's chronometer until he could measure distance five times more minute than that. As the carpenter seldom finds it necessary to consider anything less than the thirty-second of an inch, and the automobile builder the five-thousandth of an inch, each trade and profession up the scale demands greater refinement, until it reaches limits inconceivable to the lay-

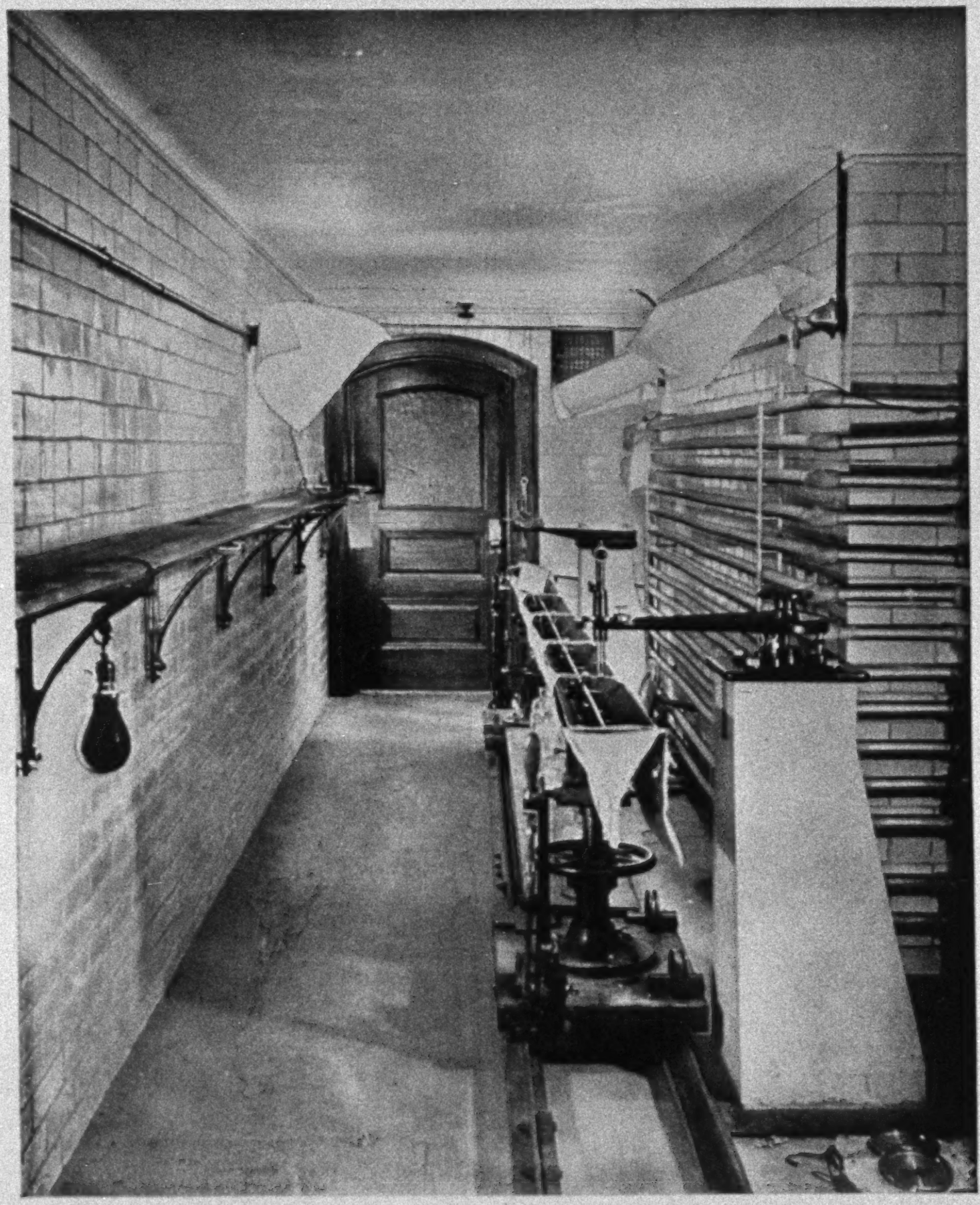


Photo from Bureau of Standards

PART OF THE TESTING TUNNEL

Here is the five-meter bar in place in its ice bath and mounted on its traveling carriage. The picture also shows two of the piers on which the observing microscopes are mounted, and on the opposite side part of the 164-foot comparing bar (see page 158).

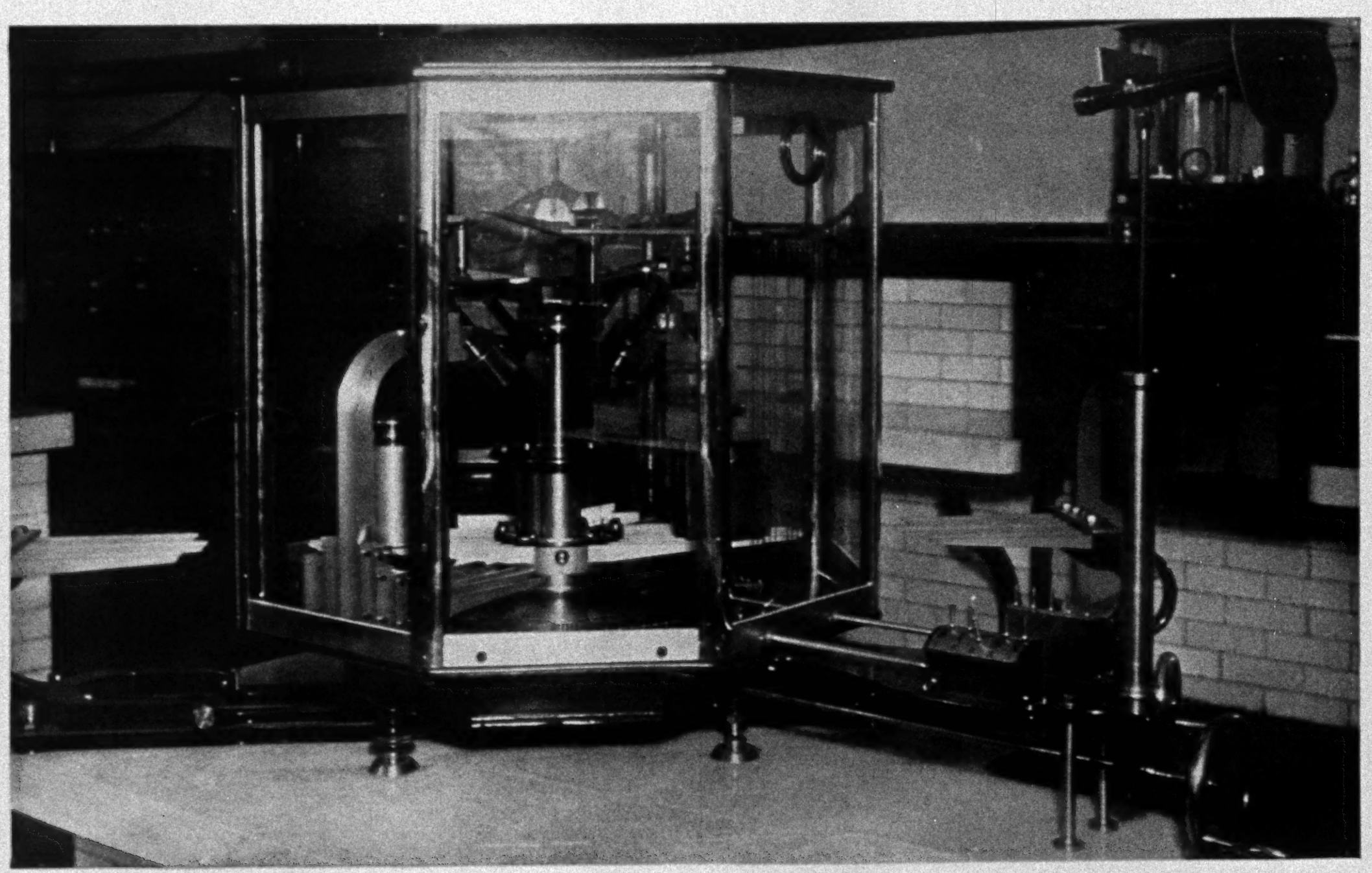


Photo from Bureau of Standards

This large balance is so accurate in its work that it can tell the exact weight of the object tested down to 1/100,000,000th part. It is operated in a glass case lest the unnoticeable air currents of the room interfere with its precision (see text, page 161)

man, and yet in the end as important to him as any of lower limits.

In short, then, the work of the Bureau of Standards, aside from the protection of the whole people from false measures, may be said to be that of refining the yardsticks of science.

Here can be seen instruments of such delicacy and precision that the mind at first fails to grasp the full significance of what they can accomplish.

In one room is a balance so sensitive that the mere presence of the operator's body generates an amount of heat sufficient to disturb its accuracy (see p. 153).

In another there is one so delicately adjusted that it shows the loss of weight due to the reduction of the earth's attraction when two pieces of metal are weighed one upon another instead of side by side (see page 161).

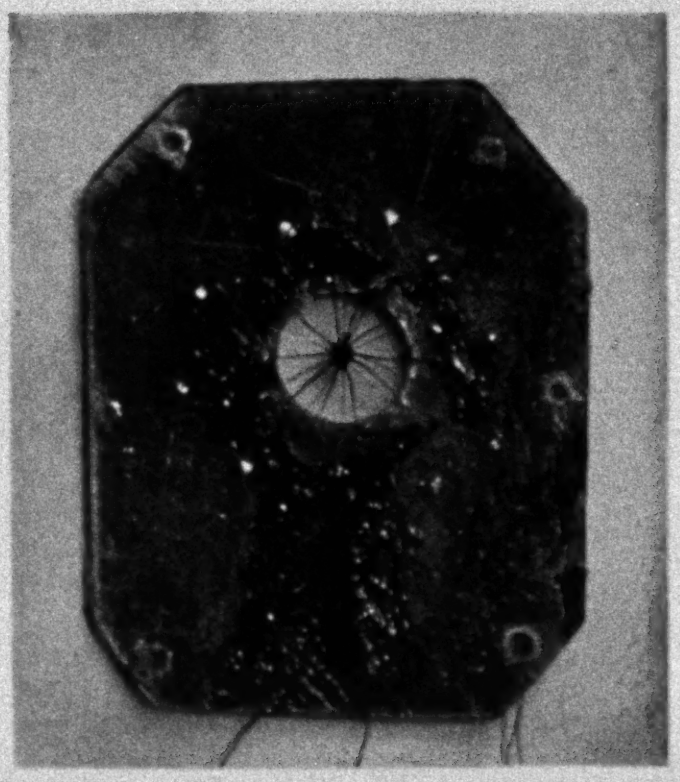
Remarkable beyond the imagination are the heat-measuring instruments which register infinitesimal fluctuations of temperature. A ray of light may have started ten years ago from some distant star, and may have spent all of those ten years hurtling earthward-bound through space at a gait so astounding that it could girdle the globe in far less time than it takes to blink the eye; and yet when it falls upon the sensitive bolometers at the Bureau of Standards they will tell the observer how much heat that ray brought with it from the star to the earth.

Such are a few of the most delicate instruments. But there are others which are as powerful as they are sensitive.

In the engineering laboratory there is a huge testing machine which can tear apart the strongest steel girders used in building great sky-scrapers, while on the floor above are little electrical furnaces capable of generating a heat intense enough to melt the most refractory materials. The Bureau can measure accurately cold great enough to liquefy the very air we breathe, and heat which can melt solid rocks (see also page 165).

SUGAR COSTING $15 PER POUND

This is a commercial age, and even this institution, so eminently scientific, has something to sell. For example, it will supply pure—absolutely pure—sugar for the trifling sum of $15 per pound—under cost price, in fact; and yet, surprising as it may seem, there is a ready sale.



THIS MEASURES THE QUALITY OF A STAR'S HEAT

This instrument, which is called a thermopile, is here shown mounted so as to fit into the eyepiece of a telescope. Its effective part is the little black spot in the center, smaller than the average pin-head; yet with its assistance not only the quantity, but also the quality, of the heat given off by a selected star can be ascertained. The picture is enlarged to three times the natural size of the instrument.

But the average man may very well say, "I can buy all the sugar I want at 6 cents a pound, and I have no earthly interest in the quality of a star's heat; how does this Bureau affect me?"

Directly it affects him not at all; indirectly it touches him at almost every hour of the day. Though he may not know it, he probably pays for his gas by the heat value fixed by that high-priced sugar, his electric-light bulbs by the candle-power determined here, his meats by the weights, and his wines by the measures the Bureau has standardized. The imported sugar at his breakfast table, the rails over which he traveled to the city, the concrete flooring in his fireproof office building, the steel girder supporting the roof above his head, all owe a debt to the researches conducted by the Bureau.

NEW MEASURES CONSTANTLY COMING INTO USE

Formerly weights and measures were restricted to length, area, volume, and

weight; but now the scope of weights and measures is immensely broadened, for many new commodities are in the market which were formerly unknown, such as electric current, light, heat, refrigeration, and services of other kinds. The term "measures" now includes the measurement of energy, velocity, power, illumination, and electricity.

The standardization of these new and often intricate measures requires very elaborate equipment and a high standard of scientific attainment in the worker.

THE SORT OF PEOPLE WHO NEED THE BUREAU

Perhaps the best idea of the far-reaching work of the Bureau may be gained by glancing over the mail arriving any morning at the Director's office. Here are letters from iron-founders, tanners, iron-pipe makers, textile engineers, optical instrument makers, dyers, photographers, universities, well-sinkers, Chicago meat-packers, glass-makers, municipalities, manufacturers of refrigerating plants, contractors in concrete, railroad officials, lamp-makers, boiler-makers, chemical manufacturers, railroad commissioners, glass-blowers, paper-makers, officials of international scientific commissions, makers of fine-mesh cloth for sieves, engineering firms, dry-goods houses, officials of almost every department of the federal government, makers of oleomargarine, carpets, water-meters, gas-meters, and watches, and, finally, officials of foreign governments.

Thus the Bureau does for the manufacturer something of what the Department of Agriculture is doing for the farmer.

THE STANDARDS OF ALL MEASURES OF WEIGHT AND LENGTH

Perhaps the division of weights and measures has a greater interest for the layman than any other division of the Bureau. Here are preserved the fundamental standards on which all measures of weight and length depend. These are kept under double glass cases in a fireproof safety vault and are never used except to check the copies that have been adopted as working standards.

The unit of length is the meter, which is defined as the distance, at the temperature of melting ice, between two fine lines ruled on a bar of platinum-iridium, which is kept at the International Bureau of Weights and Measures at Breteuil, near Paris, France. Accurate copies of this bar have been made and distributed to the various governments of the world; that preserved at the Bureau is No. 27.

In shape it resembles the letter H, with the uprights bent slightly outward. The scale marked upon it is so fine as to be almost invisible to the naked eye. When this prototype is to be compared with any other meter, both bars are placed side by side in a receptacle, which is then placed in an oil bath in a trough-like comparator, which is kept at an even temperature. Microscopes are mounted on an invar-steel bar, and with the most delicate micrometer screws are adjusted to the prototype; the standard to be compared is then brought beneath them and the difference, if any, is recorded. Observations are made to the 1/254,000th of an inch (see page 155).

Measures of considerable length—as, for example, the invar tapes used in the United States Coast and Geodetic and the Geological Survey—which are tested by the Bureau before and after each expedition, are compared in a long tunnel in the basement of the main building. This tunnel is kept at an even temperature by means of a series of hot and cold pipes, and a five-meter bar, packed in ice and mounted on a movable carriage, together with microscopes mounted on independent piers at fixed intervals, is used to test any bar or tape up to 50 meters in length. On the other side of the tunnel is an iron bar 164 feet long, in which platinum-iridium plugs are inserted at intervals. This also is used for testing tapes and similar measures requiring less exact determination.

The standard of mass, which most people call weight, is the kilogram (see page 154), also of platinum-iridium, and comes, like the meter, from France. The Bureau possesses the two copies of the original kilogram numbered 4 and 20. From this prototype all other weights, such as the pounds avoirdupois and Troy, are derived.

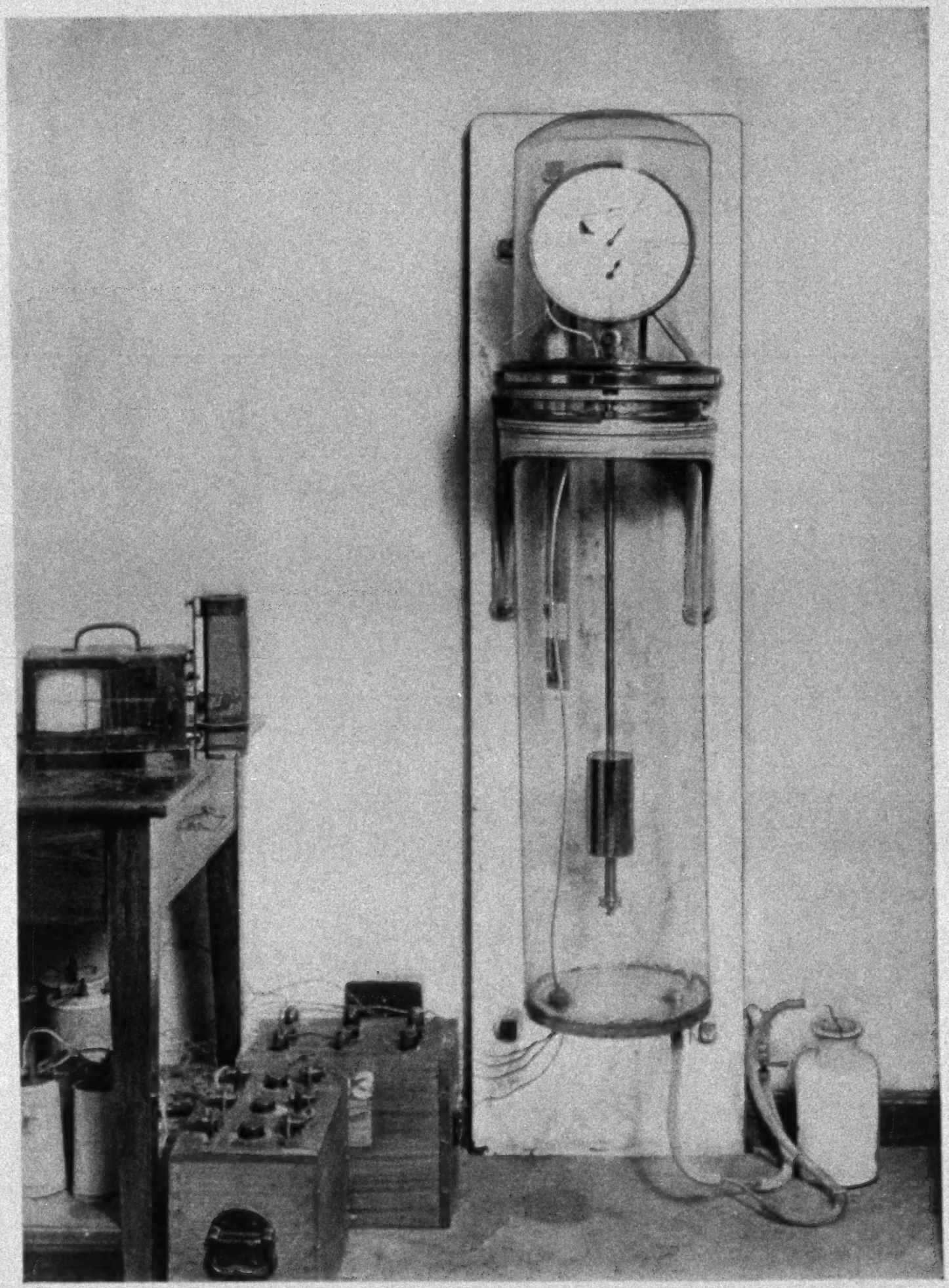
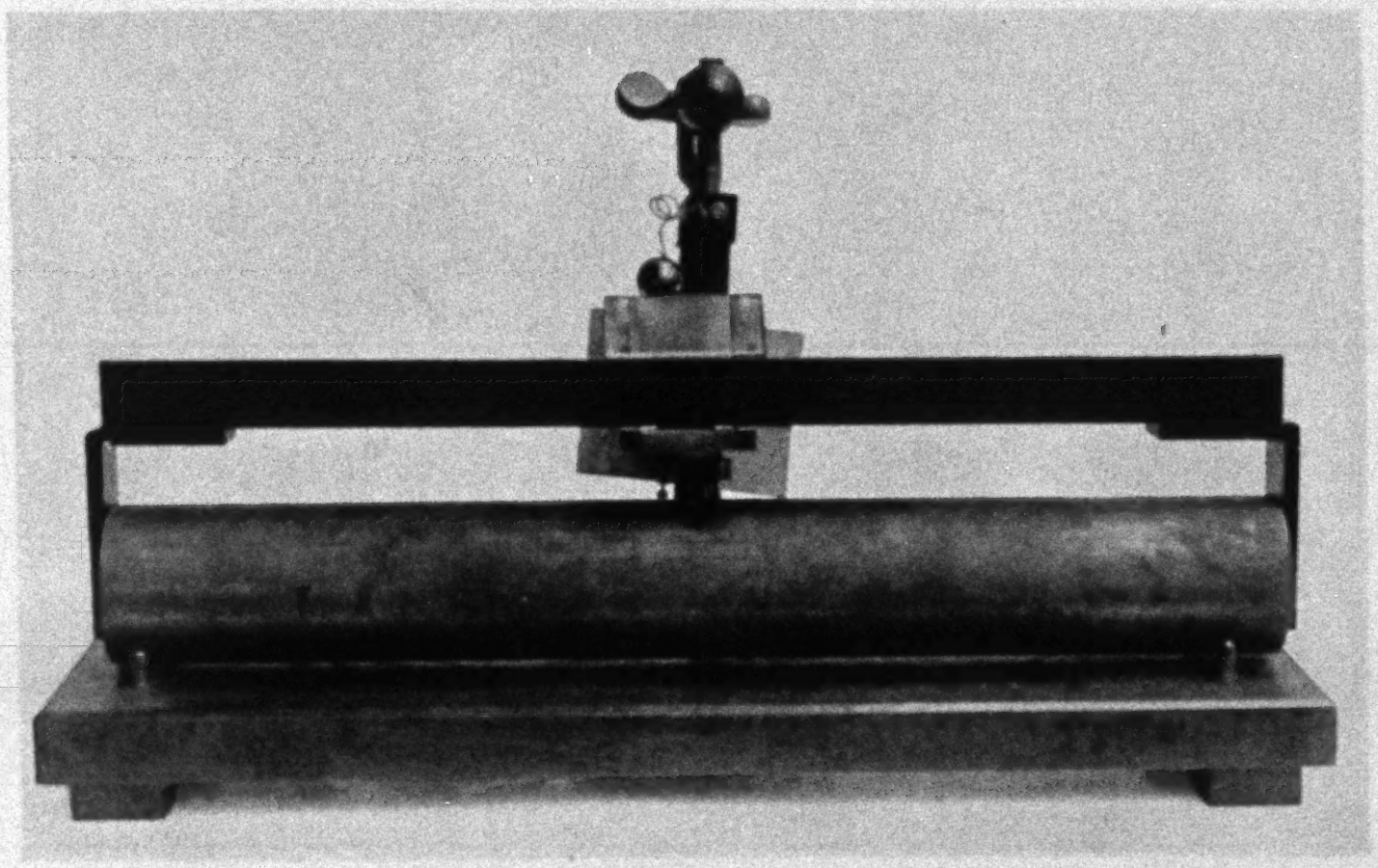


Photo from Bureau of Standards

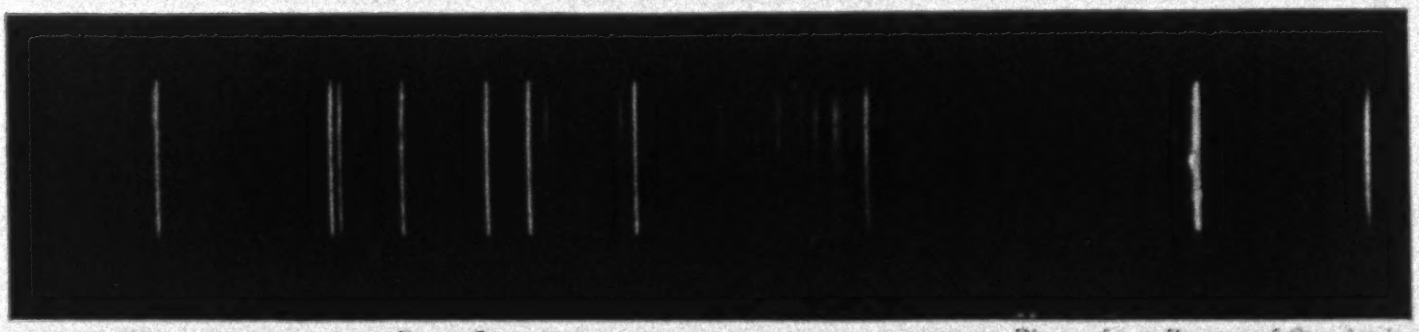
A MARVEL OF PRECISION: THE RIEFLER CLOCK

This is the most accurate type of clock made and will keep time to within a variation of half a second a month. Its pendulum is of nickel steel, so that the expansion is negligible. It is self-winding and runs in a partial vacuum. It is regulated by admitting more or less air into the partial vacuum, and it is kept in a constant temperature vault, every precaution being taken to free the atmosphere from moisture. It is checked every day by observations taken at the U. S. Naval Observatory.



A REMARKABLE SCIENTIFIC APPARATUS, WITH WHICH THE VISITOR CAN SEE THE BENDING OF A HEAVY STEEL BAR BENEATH THE PRESSURE OF ONE FINGER

This bar is supported at each end and a small mirror is fixed at the center. Above it is a frame bearing another partially silvered mirror, both of which reflect the light of a sodium burner, the lower mirror showing a series of purple and yellow concentric rings. The slightest pressure on the bar—even the weight of a visiting card or a pin—causes these circles to expand outward, forming, as it were, a series of ripples like those made when a stone is dropped into the center of a still pond. The pressure of one finger on the bar causes the formation of five or six new circles, showing that the bar has been bent about one twenty-thousandth of an inch, as each new circle means a movement of one hundred-thousandth of an inch (see illustrations, page 161).



A B C

Photos from Bureau of Standards

THE LIGHT WAVES ARE USED AS UNITS OF MEASURE

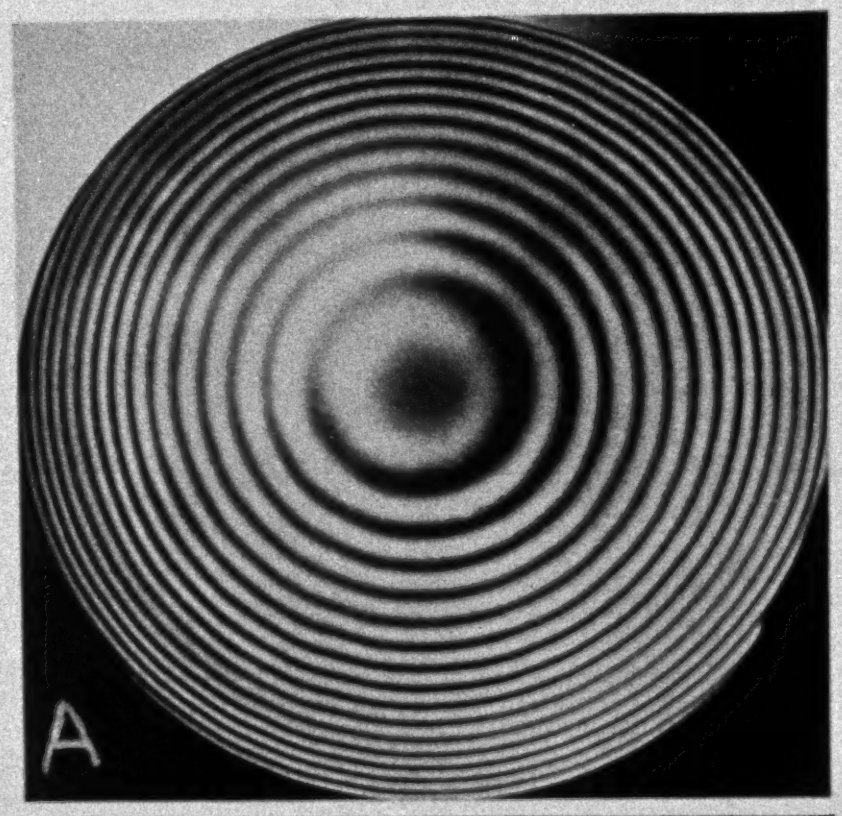
If all the standards of length in the entire world were by some accident destroyed, the meter could be exactly reproduced from the red line in the spectrum of cadmium, as it is invariable (see page 165). This illustration is a photograph of the spectrum of cadmium vapor, showing the three lines (marked A, B, and C) used to determine the international meter, the world's standard of length. These lines never vary and are exactly 64,384,696, 50,858,219, and 47,999,087 millimicrons long respectively. A millimicron is a thousandth part of a micron; a micron is a millionth part of a meter.

The weights tested by the Bureau range from those used by city and State scalers in testing the weights and measures of commerce down to those used by scientists in most precise and exacting work. To do such testing as this the very finest instruments are required, and weights which vary from great masses as big as a steamer trunk down to tiny atoms which would look lonely on a pin's head. The smallest of these is the 1/20th milligram, or 1/600,000th of an ounce. Though made of the lightest metal known, aluminum, when set on a balance one has to look carefully in order to be sure that it is not a mere scratch on the surface of the weighing pan. The balance on which this weight is used can weigh with accuracy down to 1/50,000,000th of an ounce.

On one of the balances the weighing is made in a vacuum, so that the weight and buoyancy of the air does not interfere with the result.

Another balance is so sensitive that it can detect the difference due to the diminution of the earth's attraction. To prove this, an experiment was specially made for the purposes of this article. Two kilograms were weighed side by side, then one kilogram was placed on top of the other, and was thus elevated 5 centimeters (about 2 inches). It was found that the weight was 0.016 milligrams less than when they were side by side. The precision of this instrument can be appreciated by this experiment, for it shows that it can weigh down to 1/100,000,000th of the whole. This balance is shown on p. 156.

Some of these bal-



Photos from Bureau of Standards

TESTING A GLASS SURFACE FOR SUBMARINES (SEE P. 165)

Figure A shows the concentric rings which appear on a true surface when tested by the interferometer (see page 160). In this figure the surface is very nearly, but not quite, true; so that the rings are not perfectly regular. Figure B shows how an untrue surface responds to the interferometer. This instrument is a very valuable one and upon it the lives of men can depend, as, for example, those of the sailors in a submarine who depend entirely upon the periscope for guidance. Should the surfaces in the periscope be untrue, the pilot may easily be led into a situation in which the lives of the crew may be jeopardized.

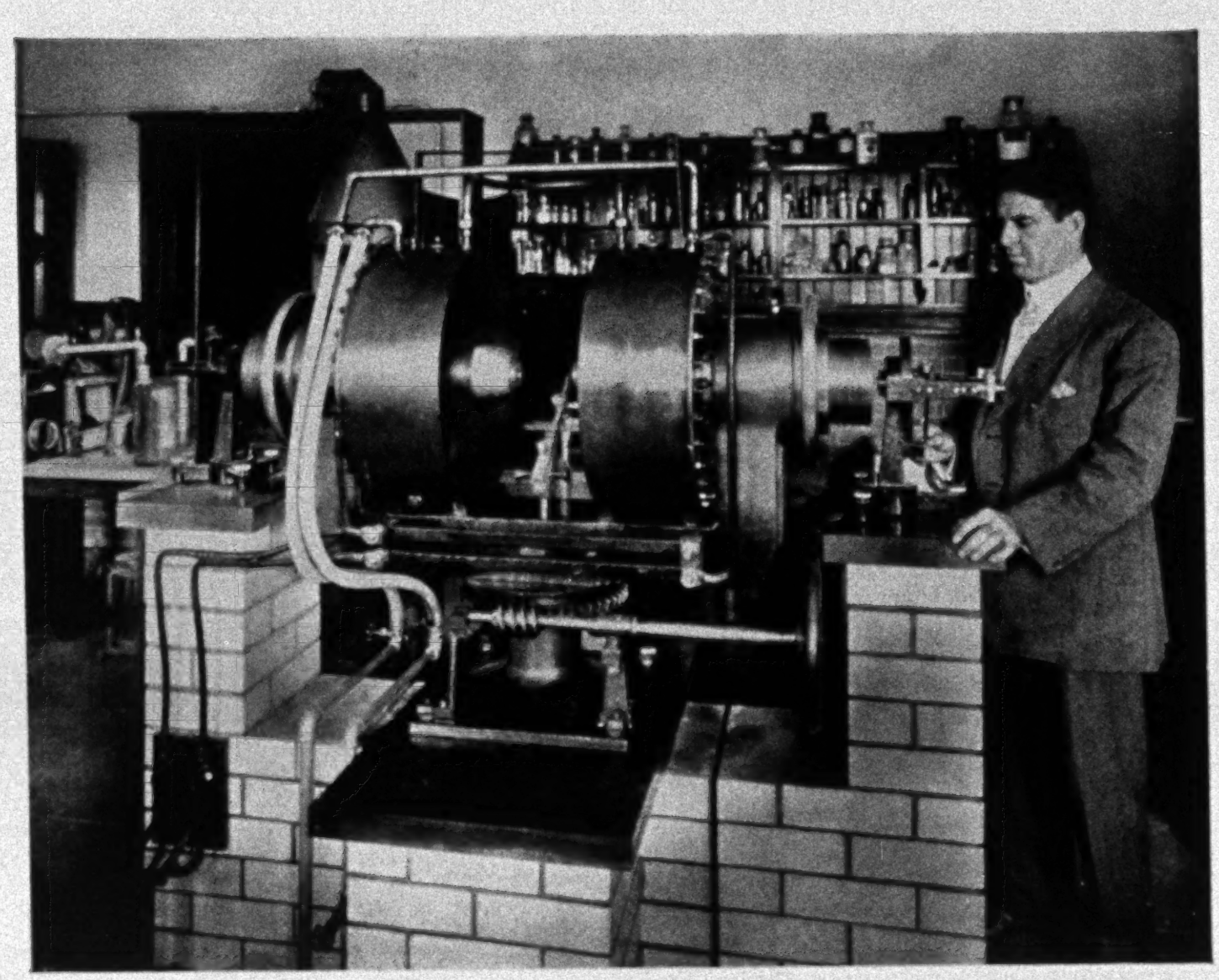


Photo from Bureau of Standards

THE MOST POWERFUL MAGNET IN THE WORLD

This magnet is so powerful that it will draw nails resting on the palm of a hand from a considerable distance; or, if the nail is placed in the closed fist, the attraction of the magnet is so great that the hand can be turned with only great effort. The magnet is used to study the strange effect of magnetism on light waves.

ances are so delicate that the heat of the operator's body near them would cause a disturbance, and the adjustment is effected by rods and other ingenious mechanisms, which change the weights from pan to pan or add the finer V-shaped weights to the cross-beam to effect a perfect balance. The operator stands at a distance of 10 feet (see page 153) and reads the result through a telescope.

One of the balances used in the voltameter work is so delicately adjusted and sensitive to changes of temperature that the operator cannot even remain in the same room with it. It is kept in a room guarded by double doors, in which a constant temperature is preserved. The rods by which it is controlled reach through double glass panels into a second room, which is also at an even temperature and guarded, too, by double doors. In fact, to approach this balance is a ceremony. One descends into the crypt; four doors have to be unlocked in turn; lights have to be lit; and, finally, if one is specially favored, the glass case which envelops it may be opened for a brief inspection. One feels that the poor thing suffers physically when subjected to morbid curiosity.

Every precaution is taken that the weights are not touched. They are kept in glass cases and dusted with camel's-hair brushes. Forceps are used to handle the smaller weights, and lifters covered with chamois leather for the larger ones, as the deposits from even the cleanest hands would render them inaccurate.

One division is conducting a series of very important investigations upon the

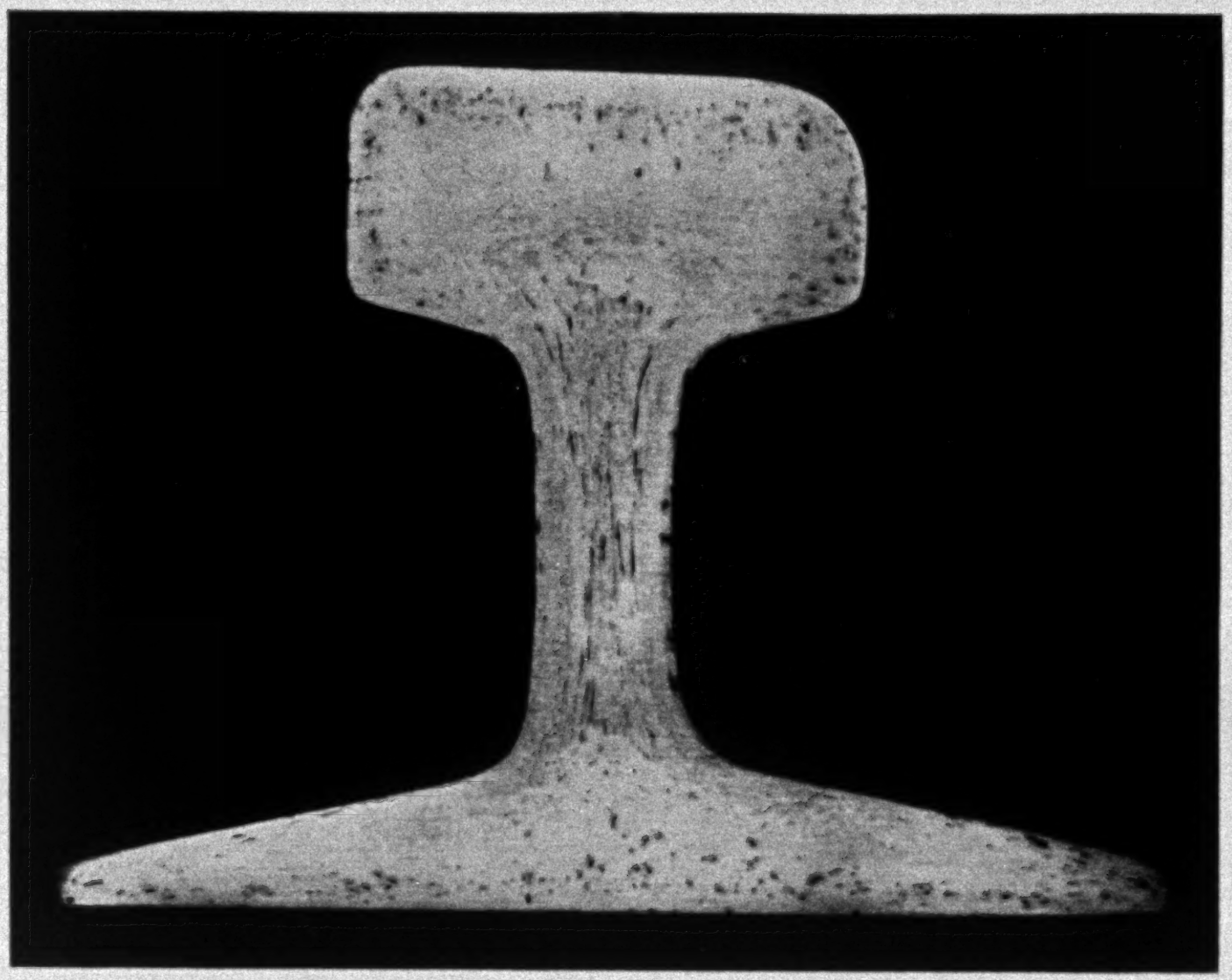


Photo from Bureau of Standards

A RAIL THAT FAILED

This cross-section of a rail which failed under the pressure of a passing train shows numerous flaws in the steel. At present there is no certain means of ascertaining if such flaws exist without cutting into the rail, and thereby rendering it useless. The Bureau of Standards is working to discover tests which will be both accurate and applicable to the rails actually to be used on the permanent way.

behavior of aneroid barometers, which are of the greatest interest to the geographer, to the explorer, the surveyor, the mountaineer, and the aviator, for the aneroid is an instrument of the highest importance in their work.

WHY AVIATORS' FIGURES ARE UNRELIABLE

Experiments show that the effect of temperature is usually negligible compared with the mechanical and elastic errors to which even instruments by the very best makers are liable. It has been found that an aneroid carried slowly up the side of a mountain will give an entirely different reading to that given when taken rapidly up the same mountain in an electric railway.

As an instrument for measuring height it has been proved very unreliable unless thoroughly studied; so that when an aviator announces from the readings of his instrument that he has made an ascent of 15,748 feet his figures may be promptly discounted, the real truth being that the ascent was probably about 15,000 feet or even less, or that it might have been over 16,000 feet, depending upon the method of making the instrument.

To show how unreliable such figures are when uncorrected, seven aneroids of the best-known make, each of them as fine an instrument as could be procured on the market, were taken up together in the same aëroplane. The ascent was made, the height recorded, and the machine descended. Then the readings of the seven aneroids were examined, and it was impossible to find out how high

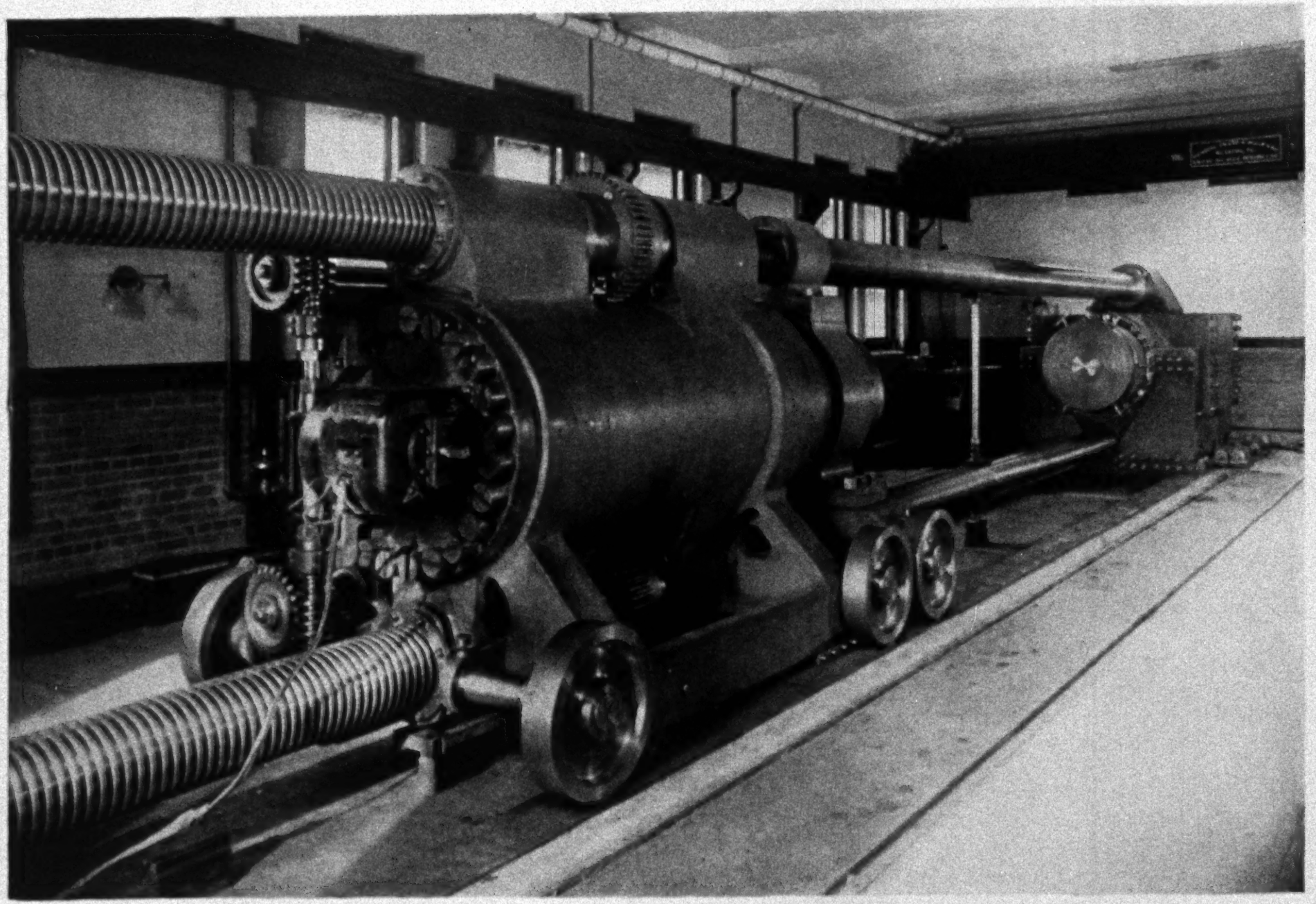


Photo from Bureau of Standards

THE GIANT TESTING MACHINE WHICH CAN REGISTER WITH EQUAL ACCURACY THE POWER NECESSARY TO CRUSH AN EGG-SHELL OR TO TEAR APART THE STRONGEST STEEL GIRDER

This machine will test any piece of iron, steel, or other material from a few inches in length up to 35 feet. It can exert a pulling strength of 1,150,000 pounds and a crushing power of 2,300,000 pounds. The great screws are 40 feet long and 1 foot in diameter. Oil is used in the cylinders instead of water to furnish the necessary power.

the aëroplane had ascended without a careful study of each instrument; for one instrument recorded a height of over 2,000 feet, the highest reading, while the lowest reading was 670 feet less, or something under 1,400 feet.

MEASURING HEAT BY LOOKING AT IT

In the division charged with the standards of heat, researches are being conducted which it is hoped will lead to international agreement as to the standard scale of temperature; for, strange as it may appear, only two points are at present standardized, namely, the freezing and boiling points of water; above and below these nothing is fixed.

Here the clinical thermometers used by the medical profession are tested and their accuracy to the tenth of a degree certified, upward of 20,000 being handled in the course of a year. Here are tested the delicate Beckman thermometers, which are used by chemists and engineers in the trials on which the award of large fuel contracts are based. The high-temperature thermometers, reading up to 1,000° Fahrenheit, and the low-temperature pentane thermometers, used for temperatures as low as 300° below zero Fahrenheit, also receive their share of attention.

In another room is to be found apparatus by which such intense cold can be produced that even the air we breathe becomes liquefied, and can be handled as so much water. Put a bar of steel into it and it will burn as if it were tinder, in spite of the fact that the steel and the air have been intensely cold.

Hard by is another room where they go to the opposite extreme, to the point where we begin to realize the meaning of the expression "fervent heat." Here the hardest metals that exist melt as a pile of snow before an April sun; and yet they have to devise heat-measuring instruments as sturdy as the bolometer is delicate, so that they can endure it and register its temperature.

In high-temperature work the Bureau measures accurately heat up to the temperature of the sun by means of complicated and delicate instruments known as pyrometers. These instruments are used in many industries; for example, in the hardening, annealing, and tempering of steel, the melting and pouring of molten metals in foundries, the burning of ceramics, the melting and annealing of glass, etc., and many are tested and standardized by the Bureau.

High temperatures emitted by bodies when they are incandescent or at red or white heat are measured by optical or electrical means. Thus, for example, the bolometer measures by optical methods very small amounts of radiant heat and can record accurately changes of temperature of less than a millionth of a degree Fahrenheit.

BENDING A STEEL BAR WITH ONE FINGER

In the division of optics many tests are made for the government and the general public of telescopic and photographic lenses, prisms, samples of glass, and optical instruments and accessories. Work has been planned which will lead to the standardization of the colors of textiles, papers, tobaccos, butter, dyes, liquors, and many other commodities.

The fundamental basis of the work of this section is the light wave. If all the standards of length in the whole world were by some accident destroyed, the meter could be exactly reproduced from the red line in the spectrum of cadmium, as it is invariable, exactly 1,553,163.5 of these wave-lengths forming the length of a meter (see picture, page 160).

Light waves form the unit of measurement in one of the most precise instruments known to science. This is the interferometer, which can accurately determine differences in length as small as two-millionths of an inch, or measurements so minute as to be beyond the range of the microscope.

To show the delicacy of this method, the Bureau has evolved a remarkable scientific device (see p. 160), with which the visitor can see the bending of a steel bar 3 feet long and 3½ inches in diameter beneath the pressure of one finger. This bar is supported at each end and a small mirror is fixed at the center: above it is a frame bearing another partially silvered mirror, both of which reflect the light of a sodium burner, the lower mirror showing a series of black and yellow concentric rings (see Fig. A, page 161). The

slightest pressure on the bar—even the weight of a visiting card or a pin—causes these circles to expand outward, forming, as it were, a series of ripples like those made when a stone is dropped into the center of a still pond. The pressure of one finger on the bar causes the formation of five or six new circles, showing that the bar has been bent about 1/20,000th of an inch, as each new circle means a movement of 1/100,000th of an inch.

At first sight the testing of sugar would seem, to the lay mind at least, to belong to the department of chemistry rather than optics; but it has been found that the most perfect test of sugar is an optical one. The amount of impurity is found by watching the twist of a light wave passing through a sugar solution of a certain strength. This is effected in an instrument known as a saccharimeter, and on these tests the import duty is based. Samples of sugar are sent daily by the customs service at the various ports of entry for check analysis, and in this way uniformity of analysis at the custom-houses all over the country is secured.

In the division of chemistry nearly 9,000 tests are made in a year and almost all of them for the government. Commissions are only accepted from private bodies when such work cannot be done anywhere else, for the Bureau declines to enter into competition with private laboratories; under exceptional circumstances, however, umpire testing or analysis is undertaken.

TESTS THAT INSURE THE SAFETY OF SKY-SCRAPERS

In the engineering division the most impressive feature to the layman is the huge Emery testing machines; the larger one has a 2,300,000 pounds compressive power and a pulling power of 1,150,000 (see page 164), while the smaller one has a tension and compression strength of 230,000 pounds.

These great machines are of wonderful delicacy and power; for, after exerting and accurately registering a pressure sufficient to break a huge steel girder, an egg-shell can be crushed and the force exerted recorded with equal accuracy.

In the branch of the Bureau at Pittsburgh a still more powerful machine has been installed—the great 10-million-pound Olsen testing machine (see page 167). These machines are used in a series of investigations conducted jointly by the Bureau and the American Society of Civil Engineers to check and correct the formulas for computing column strength, the formulas upon which the efficiency and safety of building construction depend.

Another very interesting series of researches is in progress, which may have the effect of saving many valuable human lives. Railroad companies send to the Bureau rails that have failed, and efforts are being made to discover a new method of testing them. At present when a rail (or any other piece of iron or steel) is tested it is destroyed in the process and becomes useless. Often a rail is full of flaws, like that shown on page 163, but at present there are no means of discovering this until the rail fails beneath the pressure of the express that thunders over it.

For the last six years the experts of the Bureau have been seeking for a method of testing the rails that will actually be used, and have conducted a series of mechanical and magnetic tests to discover some mechanical properties which can be proved always to accompany certain magnetic properties.

The results of the work are so hopeful that those engaged upon these researches are justified in believing that further studies along these lines will eventually lead to success.

WHAT IS THE STRENGTH OF RED TAPE?

In another division are tested a bewildering variety of commodities used by the government—ink, paper, rubber, clay, bricks, oils, ropes, leather, cloth, silk, sealing wax, mucilage, paint, and a hundred and one other things. Everything handled by the Federal government is tested here, from the steel for the locks on the Panama Canal down to the brushes used to sweep out departmental offices.

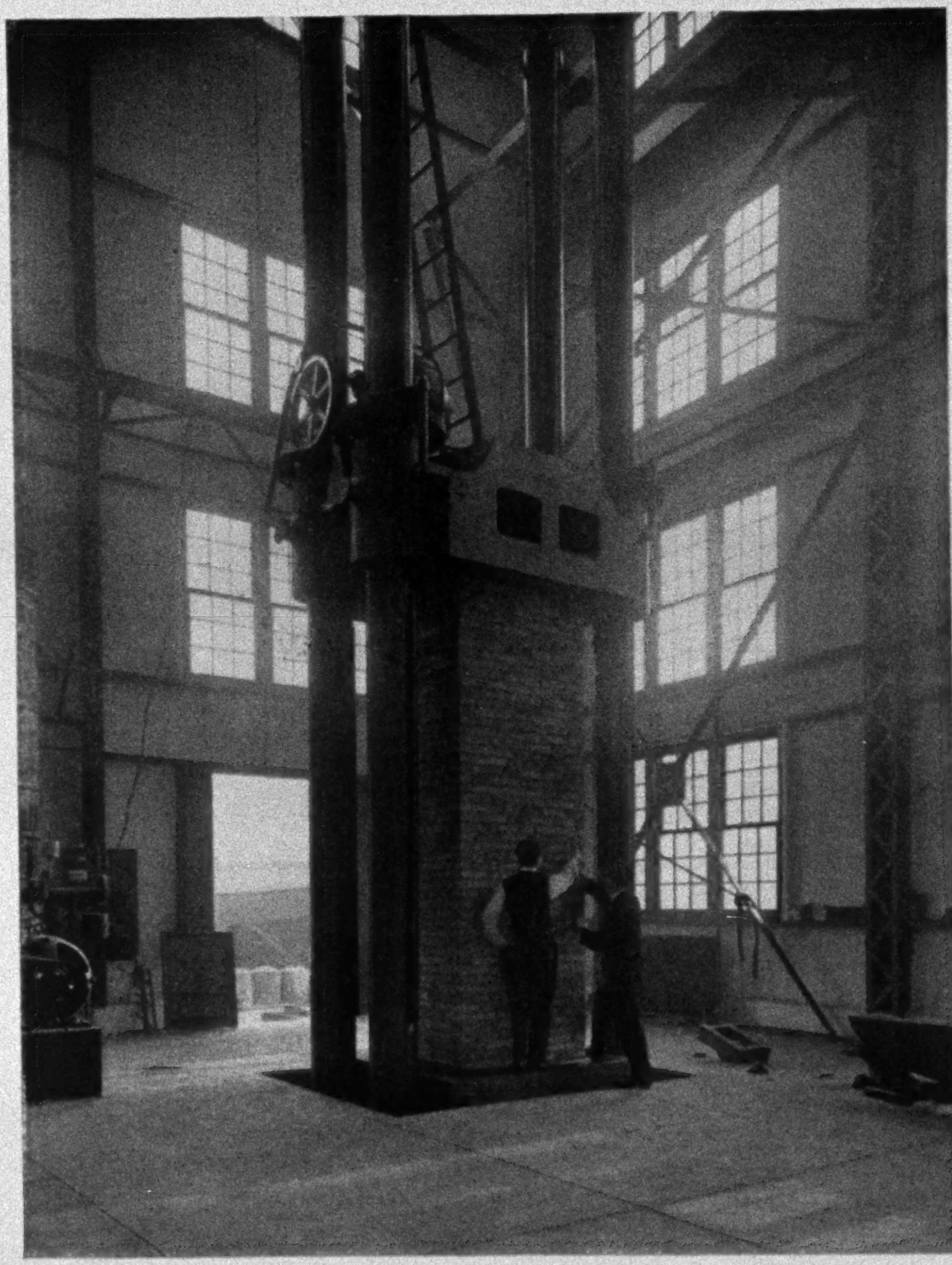


Photo from Bureau of Standards

THE MOST POWERFUL MACHINE IN THE WORLD

This great Olsen testing machine, located at the Pittsburgh laboratories of the Bureau of Standards, is used for determining the crushing (compressive) strength of materials and in testing great columns of steel or masonry. It can exert a pressure of 10,000,000 pounds, which is sufficient to break the steel shaft of the greatest war vessel afloat. The picture shows a 48-inch brick pier, 16 feet long, fitted into the machine and about to be tested.

Photo from Bureau of Standards

A BONFIRE OF SHORT MEASURES

This shows the destruction of a pile of short measures condemned and confiscated by the city sealer of one of our large cities. It has been found that dry measures are the most faulty, nearly 50 per cent of those tested by the Bureau of Standards being incorrect. When this institution began its investigations there were only four States which had efficient systems of inspecting weights and measures; now there are twenty-four (see page 169).

Even that well-known article, red tape, receives due attention; its material is examined; its color tested; its breaking strength established; its every property is determined, with the solitary exception of its obstructive force, as that is beyond the power even of the Bureau of Standards.

Nearly 30,000 samples of the cement bought by the government were tested last year, representing a purchase of more than 2 million barrels.

It has been found on submitting concrete to steam curing that in many cases the compressive strength per square inch may be increased as much as 500 per cent or more, while in other cases the concrete simply crumbled away. This striking difference is assumed to be due to presence of harmful material in the concrete that failed. Further experiments are being made, as it is hoped that this simple steam test will finally eliminate the tedious and costly tests now in use and that the composition of concrete may be in some measure standardized.

HOW MUCH SILK DOES A SILK DRESS CONTAIN?

In the textile division investigations are conducted into the physical properties of materials, from the raw fiber to the finished article, and it is interesting to note that many curious adulterants have been discovered. For instance, tin and tungsten salts are used to give brilliancy and "body" to silk, in some black silks as much as 40 per cent being used.

WHERE THE PUBLIC SUFFERS

The Bureau is endeavoring to secure throughout the States uniform legislation on the subject of our standards, and also the establishment of a nation-wide system of inspection. Such a system would be able to enforce the use of honest weights and measures in daily trade, the need for which is immediately apparent

when it is realized that considerably more than 100 million dollars is taken each year from the pocket of the ultimate consumer by the retailer who, often quite innocently, uses dishonest weights and measures.

During the period from 1909 to 1913 the Bureau undertook to test some of the commercial weights and measures of the country, and the revelations made thereby were startling. It was found that 44 out of every 100 scales tested were incorrect—nearly one-half of the dry measures and more than a fourth of the liquid measures. Some one has estimated that the total loss to the people as a result of this inaccuracy of weights and measures would be enough to build ten of the biggest battleships afloat every year.

When the investigation started there were only four States in the Union which had efficient systems of inspecting weights and measures. Such were the revelations that today 24 States and most of the important cities of the country have efficient inspection systems, and most of the other States are expected soon to fall into line.

The Bureau of Standards is striving to have uniform State laws for weights and measures enacted in all of the 48 States. It wants a pound to be a pound everywhere and a bushel a bushel. At present it is not always so. A bushel of potatoes may be more than a bushel in one State and less than a bushel in another, depending upon the number of pounds each State says shall constitute a bushel.

False measures have a habit of running away from progressive laws. Not long ago a hundred thousand milk jars were condemned for short measure by the sealers of a certain State. These jars were hastily collected and sent to another State, where the laws were more lax. Here they were soon overtaken by a similar fate and were hurried off to a new locality and are probably still on the move.

A CITY OF REALIZED DREAMS

By Franklin K. Lane
Secretary of the Interior

IN THE three days following April 18, 1906, the entire business and manufacturing portions of San Francisco and a large part of the residential section were swept by flames. Three hundred and fifty million dollars went up in smoke. February 20, 1915, saw that city rebuilt, more beautiful than ever, and its people demonstrating to the world their own courage and self-confidence by opening an International Exposition which, in point of situation and beauty, has had no equal.

When it was proposed some five years ago that such a fair should be held its promoters were divided as to the site. Some favored placing the fair within the grounds of that remarkable bit of landscape gardening the reclaimed sand-dunes of Golden Gate Park: but now all concede that there could have been no better site chosen than the stretch of sand which flanks the entrance to the Golden Gate, looks out across the bay and beyond to Mount Tamalpais, upon which the fair has been built. The Marin hills in their soft green coat, the red bluffs of the Golden Gate, the great vault of the sky, and the long sweep of the bay and ocean—these have made a setting worthy the foreground which man has made. The great buildings face an esplanade which runs for miles along the shore itself.

ONE BUILDING WORTH A TRIP ACROSS THE CONTINENT

It is worth a trip across the continent to spend a day looking at a single building—the Palace of Fine Arts. There is no other building like it that I know of. There is no single picture in Venice that I think so fine. You see it across a lagoon in which its colored pillars and its

many statues are reflected. It has grace, majesty, delicate coloring; and as you look upon it in early morning or at nightfall you cannot but say to yourself, "Can it be that the Taj Mahal is as beautiful as this?" Unlike most of the other buildings, its construction is of a permanent character, and it is built upon land belonging to the government so that it can be preserved.

The other architectural feature of the Exposition which made its strongest appeal to me was of a totally different kind — the monumental tower which fronts the Court of all Nations. How high it is I do not now recall. That is a matter of insignificance anyway. It is a mass of statues and sculpturing, carvings, arches, moldings, intaglios, mural paintings, and jewels. Seen by day, it is a monument of exquisite line and beautifully blended colors. Seen by night, it loses nothing in form or in color, but by the wizardry of art has been made to look as if all the Rajahs of India had poured out upon it their most splendid jewels.

It has been said that this is to be the last of the great international expositions. If so, these two architectural features make a fitting climax to all the beauties that have gone before.

There are doorways on the most ordinary of the Exposition palaces upon the sculpturing and coloring of which one could spend a day of artistic feasting. Groups of symbolic figures, great fountains, hanging lanterns, bell-towers, columns and courts, high arches, patios and splendid domes—these become almost commonplaces. And nothing looks naked or undressed, for the whole Fair City seems not to be a thing that was created for this purpose, but to have lived a long time. Lawns, flowers, eucalyptus and cypress trees, pepper and palm, orange and blossoming fruit trees surround the buildings, while the great wall which marks off the grounds is itself a hanging garden of growing flowers.

In looking upon these grounds I felt as if the artists of the earth—sculptors, architects, decorators, and landscape gardeners—had united to prove the beauty and the majesty of their own conceptions under the most kindly possible of skies.

A GREAT MOVING PICTURE

This fair, however, does not appeal merely to the esthetic sense. Its exhibits of what the world is doing are the best that can be found. One sees in walking through the buildings not piled pyramids of cans and bottles and masses of unrelated machines. It is a great moving picture.

You see the wheat itself turned into flour and made into biscuit. An automobile is constructed on a moving table before your eyes, and in two minutes the machine is constructed, the chauffeur mounts it, and rides away out of the grounds. You see the miner digging into the hillsides, sluicing the dirt, extracting the gold, the gold refined and cast into a bar. You see the great bureaus of the government in actual operation.

Life is given to the exhibits, and where it has been impossible to make exhibition of field or factory, moving army, or natural wonder the cinematograph has been brought into use most extensively. There are some sixty free moving-picture shows upon the grounds.

So much for this city of realized dreams. Now let me say a word as to its significance. It sits beside the Golden Gate. The pioneer has crossed the continent and placed there his outermost camp-fire. Here he has called his sons together and made an exhibition to the world—the new world of the Pacific—of what our civilization can do. He here makes tender to the nations across the Pacific of what is best in what we term Christian civilization, and the nations of the Orient have responded by crossing to this side of the Pacific and placing before us the best that their 10,000 years of civilization have produced.

THE NATION WILL BE PROUD OF THIS EXPOSITION

This is a true meeting of the East and the West, a friendly meeting, a meeting out of which must come better understanding of each other, a meeting from which each will materially and artistically profit, and a meeting, I believe, which will go far toward a fuller and better understanding of each other.

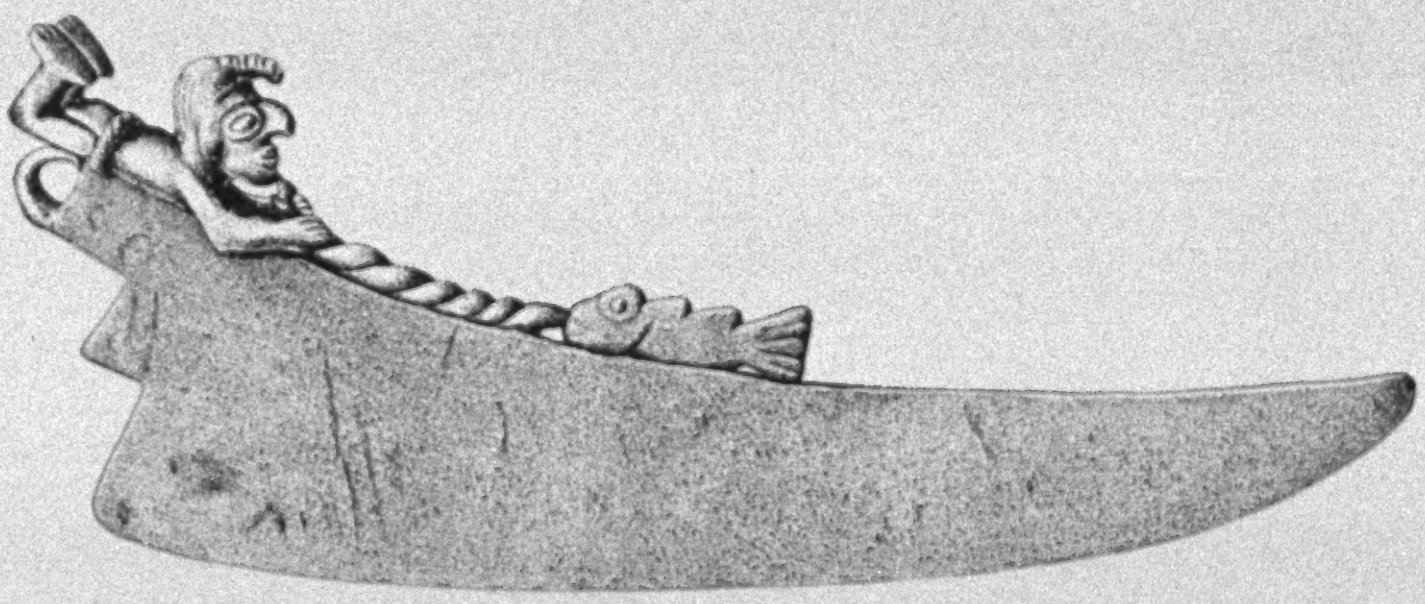
This nation should be extremely proud of this Exposition. It is in celebration of the greatest material achievement in the nation's history—the construction of the Panama Canal. The building of this canal is a proof that a democracy can be efficient, and that is something very well worth while—proving to a people who insist upon efficiency that their government may be a living and real expression of the spirit of the people who compose the nation.

Thus far in our one hundred and odd years of history we have given full bent to the strong strain of individualism that is in our blood. We have started out as a nation without national purpose or national design. We have had no policy of national aggression or acquisition. Our vigorous frontiersmen have pushed their way further and further west, to the edge of the western sea, and the government has followed lazily after, when providential circumstances opened a clear way.

When individuals have said "Let us make a highway, a canal, or a railroad" our States and our nation have given them countenance, encouragement, and rich bonuses. "Take this and let us have done with you," the nation has said. And so out of the personal initiative of the American pioneer, financier, farmer, engineer, and miner our land has been opened to the world.

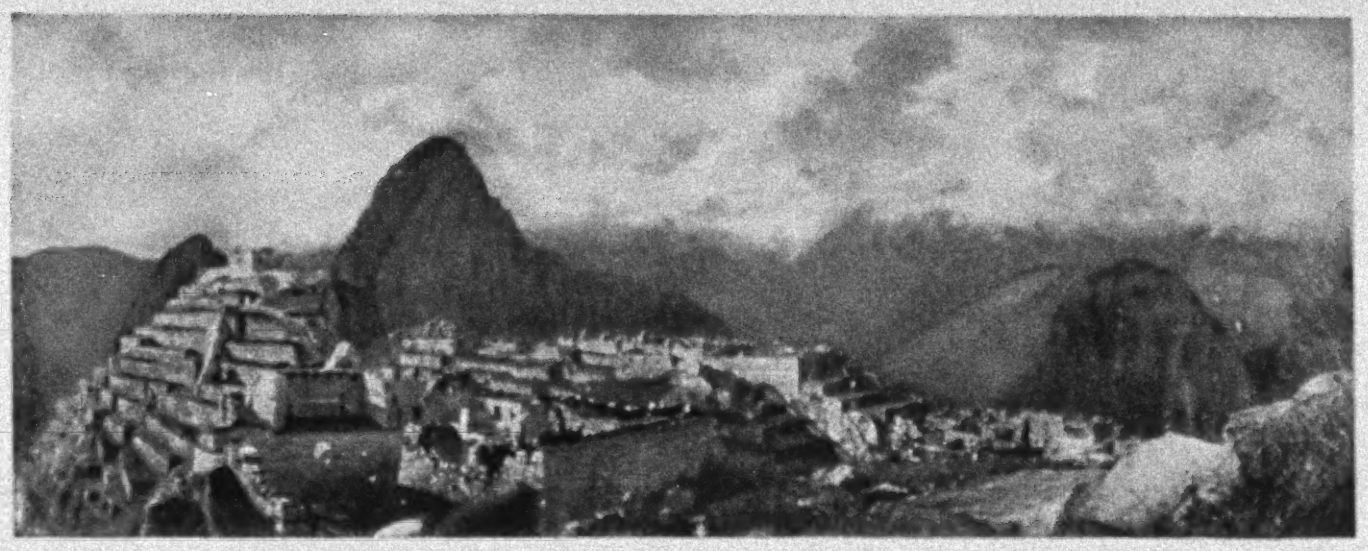
In three generations we have marched across a continent wider than Europe and crowned our achievement at our westernmost door with an exhibition of the worthiest products of our civilization. This we can say proudly is what a democracy can do.

We are coming to a fuller national consciousness not merely as a nation among the family of nations, but as a people who have common interests and can collectively do things for themselves which it would be too great a hazard to leave in private hands. The building of the Panama Canal is a long step in the making of this nation, for it has given us pride in our ability as a modern working machine.



A CHARMING BRONZE KNIFE FOUND AT MACHU PICCHU, PERU

This interesting instrument, pronounced by experts to be one of the finest examples of the ancient art of working in bronze ever found in South America, is one of the many exceedingly valuable discoveries made by the National Geographic Society-Yale University Expeditions to Peru (see article by Hiram Bingham, pages 172+).



THE LOST CITY OF THE INCAS: MACHU PICCHU

This city, probably built by the Incas 2,000 years ago, was uncovered and excavated by Prof. Hiram Bingham, under the auspices of the National Geographic Society and Yale University. Its beauty of situation and the mystery of its past make it one of the most interesting groups of ancient buildings in the world.

THE STORY OF MACHU PICCHU

The Peruvian Expeditions of the National Geographic Society and Yale University

By Hiram Bingham, Director

The Geographic Magazine *in April, 1913, printed an article, "The Wonderland of Peru," by Hiram Bingham, with 250 illustrations, describing the mysterious city of Machu Picchu, uncovered by the National Geographic Society-Yale University Peruvian Expedition of 1912, of which Dr. Bingham was the Director. Every one who read this article wanted to know when this marvelous city of refuge on the mountain top was built, for how many centuries people lived there amid the clouds, and how on the steep mountain sides they could grow enough to eat. That the researches of Dr. Bingham during the past two years have thrown much light on the puzzling history of this ancient and mysterious city discovered by him is attested by the following fascinating narrative.*

The discoveries by the expedition proved so increasingly valuable that when Dr. Bingham submitted plans for continuing explorations in Peru in 1914–1915 the Research Committee of the National Geographic Society subscribed for this purpose $12,000 from its research fund of 1914 and $20,000 from the research fund of 1915. Friends of Yale University have also generously contributed $20,000 for the Peruvian work of Dr. Bingham during 1914–1915.

Members of the National Geographic Society who have been elected since September, 1913, and who desire Professor Bingham's first report, "The Wonderland of Peru" (188 pages, 250 illustrations, and a panorama of Machu Picchu, 6½ x 18 inches), printed in the Geographic Magazine, *April, 1913, can secure copies from the Society at 25 cents each.*

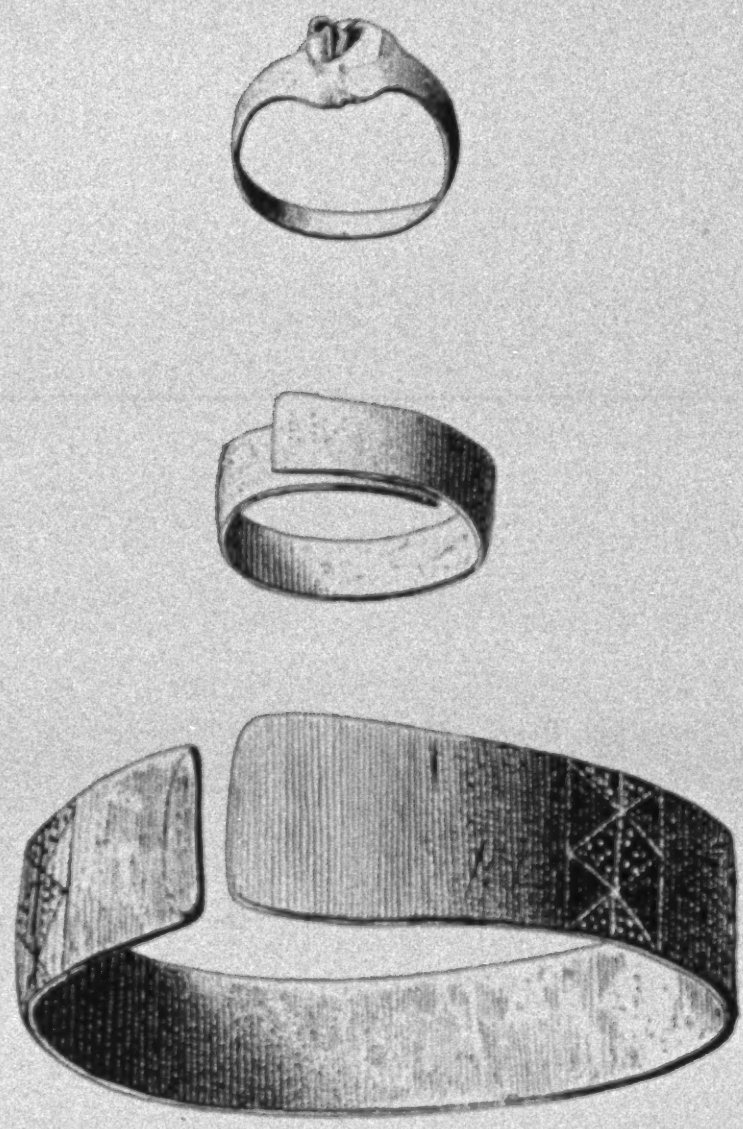
READERS of the account of the work accomplished by the Peruvian Expedition of 1912, published in the April, 1913, number of the National Geographic Magazine (pages 400-414) will remember that we felt that it was probable that the ruins now called Machu Picchu were those of the cradle of the Inca Empire, Tampu-tocco, or "Window Tavern."

During the past year and a half we have been making a thorough study of all the available ancient chronicles and of the bones, pots, and stones collected in 1912, in order to find out all we could about Tampu-tocco and see whether we

could secure any information that would lead us to confirm or abandon our first ideas in regard to the identity of Tamputocco and Machu Picchu. There is no reference to Machu Picchu in any of the chronicles.

The most satisfactory accounts of Tampu-tocco occur in the writings of Montesinos. Fernando Montesinos was an ecclesiastical lawyer, who appears to have gone to Peru in 1629 as a follower of that well-known viceroy, the Count of Chinchon, whose wife contracted malaria, was cured by the use of Peruvian bark, or quinine, and was instrumental in the introduction of this bark into Europe—a fact which is commemorated by the botanical name of the genus *cinchona*.

Montesinos appears to have given himself over entirely to historical research. He traveled extensively in Peru and wrote several books. His history of the Incas was spoiled by the introduction, in which he contended that Peru was peopled by Armenians under the leadership of Ophir, the great-grandson of Noah! More recently, however, Sir Clements Markham, the dean of Peruvian archeologists, and other students of the history of the Incas, have been inclined to place greater credence in the statements of Montesinos. His references to Tamputocco are of considerable value, because they seem to throw light on the former history of Machu Picchu.



SILVER RINGS AND A DECORATED BRONZE BRACELET OF PROBABLY THE INCA PERIOD

Found at Machu Picchu by the National Geographic Society-Yale University Expedition. 1¼ times natural size.

ANCIENT INVASIONS OF PERU

Montesinos states that during the rule of one of the Amautas, or kings, of those whom we refer to generally as the megalithic people, racial invasions took place. The invaders came to Peru from the regions south of Tucuman, in northwestern Argentina, and continued as far as the upper Vilcanota Valley. There also came over the Andes at that time large numbers of people seeking new lands, fleeing from a race of giants (possibly the Patagonians or Araucanians), who had expelled them from their own lands. On their journey they passed over plains, swamps, and jungles.

These racial migrations appear to have continued for some time. Montesinos tells us that in the reign of Pachacuti VI, the sixty-second Peruvian Amauta, who reigned about the time of Christ, there came from the Andes, as well as from Brazil and the north, large hordes of fierce people, who waged wars of long duration. During these wars the ancient or "megalithic" civilization that had existed up to that time was destroyed.

The king, Pachacuti VI, was more religious than warlike. His soothsayers and priests frightened him with many bad omens; so that, filled with anguish and melancholy, he did nothing but make sacrifices to the deities. Meanwhile he ordered his governors and captains to fortify the strategic points and make preparations for defense against the great hordes of invaders, the fiercest of which came from the south with large armies, laying waste the fields and capturing the cities and towns.

TO BATTLE ON A GOLDEN STRETCHER

The governors of the districts through which they passed were not able to resist them; so the king assembled the larger part of his army near La Raya Pass, between the basin of Lake Titicaca and the Urubamba Valley, and awaited the approach of the enemy. As soon as Pachacuti VI received word that they were near, he went out to battle and was carried about on a golden stretcher. Unfortunately he was killed by an arrow and his army was destroyed.

Montesinos quotes his authorities as stating that there were only 500 of the old army left. Leaving behind them many sick, they retired to the mountains, *going to Tampu-tocco, which was a healthy place, where they hid the body of their king in a cave.* The different provinces of the kingdom, upon learning of the death of Pachacuti VI, rose in rebellion and the people of Tampu-tocco had many disputes in respect to electing a new king.

At this time, says Montesinos, the power of the Peruvian monarchy was destroyed and did not return to its former state for over 500 years. *All record of it is lost.* In each of the provinces the people chose their own king. Those loyal to the old monarchy were very few in number and could not successfully oppose the rest of the people. *They made their capital at Tampu-tocco* and elected a king, Titi Truaman Quicho. On account of the general anarchy over all the kingdom, no one could live in Cuzco, and little by little men began to come to Tampu-tocco to live under the protection of the king, where they would be safe from the general chaos and disorder.

CUZCO DESERTED

Clearly, Tampu-tocco must have been a place well separated and set off by nature from the rest of the country, or it would not have been so easy for this disorganized remnant to have taken refuge there and set up their own king, with only 500 soldiers to support him. Machu Picchu is such a place. Paccari-tampu is not.

Cuzco was practically deserted. Apparently it had been sacked by the invaders, and the only people remaining there were the ministers of the temple.

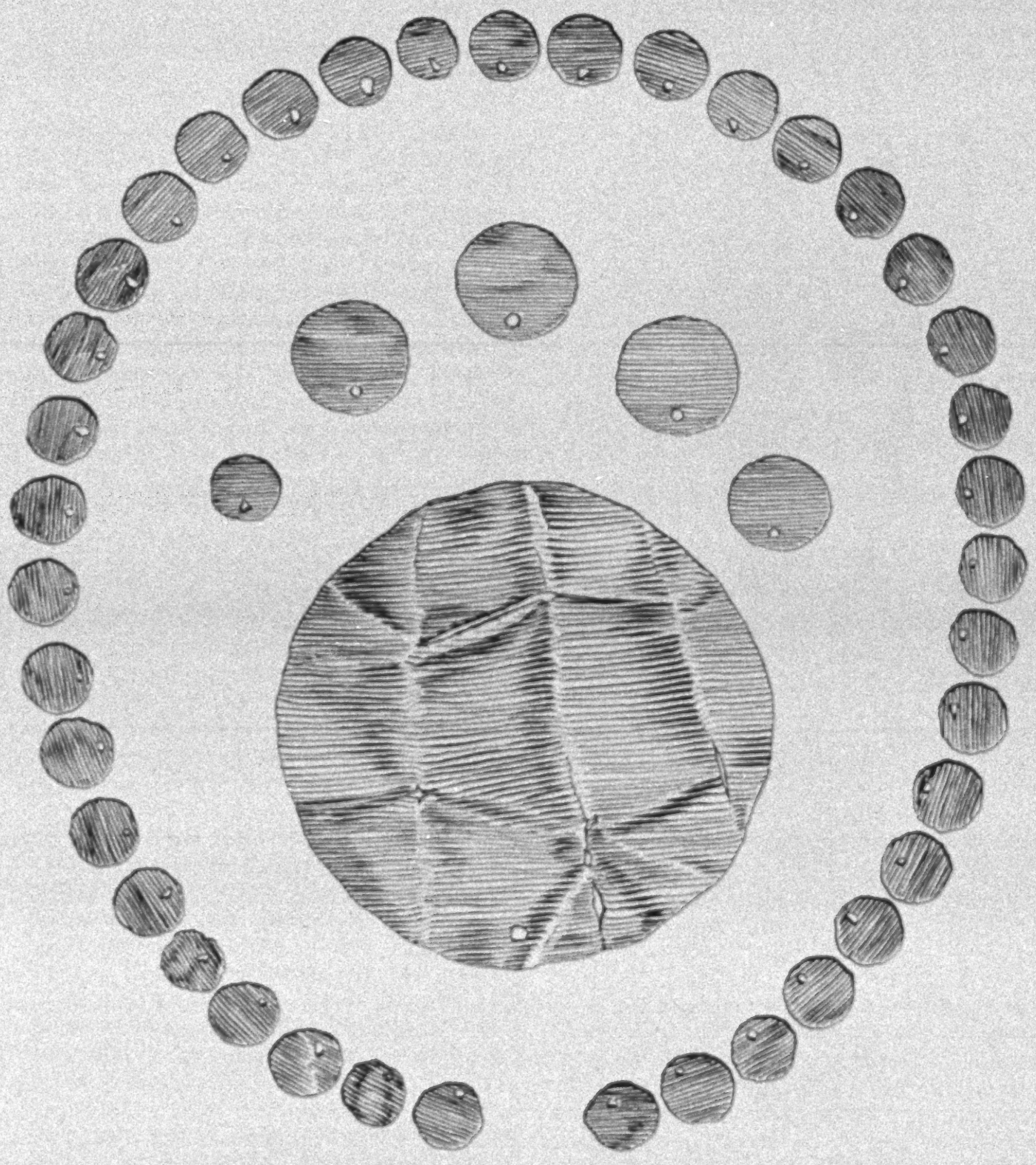
The remnants of the megalithic folk enjoyed living in Tampu-tocco, says Montesinos, because there is the very famous cave where the Incas, as the historians say, first originated, and where, they firmly assert, there never have existed such things as earthquakes, plagues, or tremblings; and because if fortune should turn against their new young king and he should be killed, they could bury him and hide him in this cave as in a very sacred place. Fortune was kind, however; they had chosen an excellent place of refuge, and their king grew up to be known as the king of Tampu-tocco. But to him and his successors nothing worth recording happened for many centuries until the reëstablishment of the kingdom in Cuzco.

It is well to remember at this point that there is no cave, large or small, at Paccari-tampu, which has for years been believed to be the site of Tampu-tocco, while at Machu Picchu there are several large caves, one of them lined with very beautiful masonry.

After about 500 years, during which time several of the kings had wished to reëstablish themselves in Cuzco, but had been obliged to give up the plan for one reason or another, a king called Tupac Cauri Pachacuti VII began to regain the power of the old kings and reconquer some of the cities and provinces. He attempted to abolish idolatry and the other heathenish practices which had become established and wide-spread since the overthrow of the old kingdom. He sent messengers to various parts of the former kingdom, asking the people to cease worshipping idols and animals and stop practicing evil customs, but his ambassadors were killed and very little reform took place.

WRITING IS FORBIDDEN

Montesinos informs us that the king consulted his soothsayers in regard to the causes of this failure in his attempts at reformation, and was told that one cause of the plague had been the use of letters. Thereupon the king ordered that under penalty of death nobody should use any kind of letters with which they had been



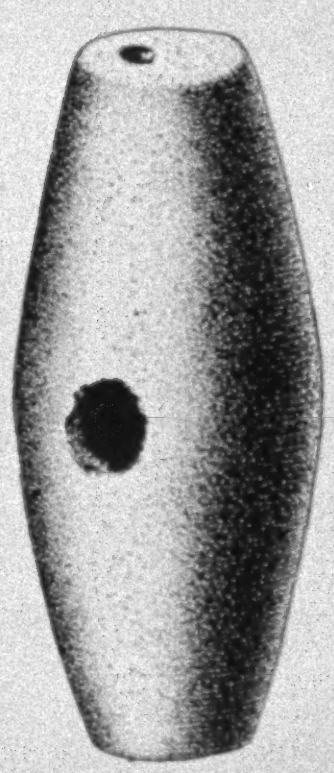
BRONZE AND SILVER DISKS USED BY THE INCAS IN NECKLACES

The large disk in the center, of pure silver, was found in excavating a house, three feet under the floor, carefully folded and hidden away by its former owner: Machu Picchu

accustomed to write upon parchment and the leaves of certain trees. This mandate was observed with such strictness that the Peruvians never again used letters until the time of the Spanish conquest. Instead they used threads, strings, and knots, as was the custom among the Incas.

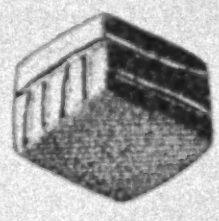
This tradition refers to an event which is supposed to have happened many centuries before the Spanish conquest. As a matter of fact, it is extremely doubtful whether the most ancient Peruvians used any kind of letters in our sense of the word; but it is quite probable that they had some method of keeping records which was lost during the dark ages, and this tradition may be an attempt to account for this loss.

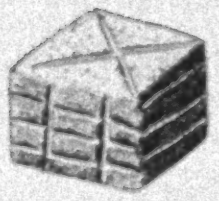
It is significant that in the oldest part of Machu Picchu we found large numbers of stone counters, like poker-chips,



A TERRA-COTTA FLUTE, OR WHISTLE, OF A RARE PATTERN

Found at Machu Picchu. Natural size





TERRA-COTTA DICE, OR TALLY PIECES

Not used by the Incas, so far as we know, but probably by the megalithic folk previous to the invention of the Inca *quipu*, or knotted string. Very little is known about these, and, while fairly common at Machu Picchu, few, if any, have found their way into the larger museums of the world. 1¼ times natural size.

and other stone tokens of a sort that were not used by the Incas, so far as we know. It is possible that these stone tokens and counters, together with certain stone slabs found near them, represent an ancient method of reckoning and keeping records before the invention of the knotted string, or *quipu*. For a further discussion of these record stones see pages 186 and 203-206.

In the more recently built parts of Machu Picchu, where we have evidence of late Inca architecture, practically none of these record stones were found; nor were any found in the graves which contained the more recent skeletal material and typical Inca pottery. The record stones may be the remains of the old system which was abandoned by the advice of the soothsayers, as Montesinos has it. As a matter of probability, it seems likely that the invention of the more convenient *quipu* caused the far more uncertain "record stone" to disappear.

A MILITARY SCHOOL

Montesinos, continuing his description of the Tampu-tocco kingdom, takes it for granted that Tampu-tocco was at Paccari Tampu, as all the other chroniclers have done, even though there is nothing there to fit into the traditions. He says that Pachacuti established there a kind of university, where the nobles were trained in military exercises and the boys were taught the method of counting on the *quipus*.

Finally, a few centuries later, when the loyalty and military efficiency of the little kingdom of Tampu-tocco was on a higher plane, the king and his council decided to attempt to reëstablish themselves near Cuzco; but an earthquake in the neighborhood of Cuzco, which ruined many buildings and caused the rivers to overflow their beds and to pass into new channels, followed by the destruction of towns, the killing of a large number of people and the outbreak of a plague, prevented the attempt from being successful. But in Tampu-tocco there was no pestilence, nor apparently did the earthquake affect that point.

It is worth remembering in this connection that a severe earthquake in Cuzco would do great damage in the village of Paccari-tampu, but might do none at Machu Picchu, built as it is in the middle of an intrusive granite formation, where, so far as one can judge from the effects on the ancient buildings, there have been no very severe earthquakes.

The inhabitants of Tampu-tocco became more and more restless, needed more arable land, and at length set out to

find it under the leadership of Manco Ccapac.

Finally, there is nothing in Montesinos' account of Tampu-tocco which calls for conditions or characteristics not found at Machu Picchu. Let us now look at another of the ancient chronicles.

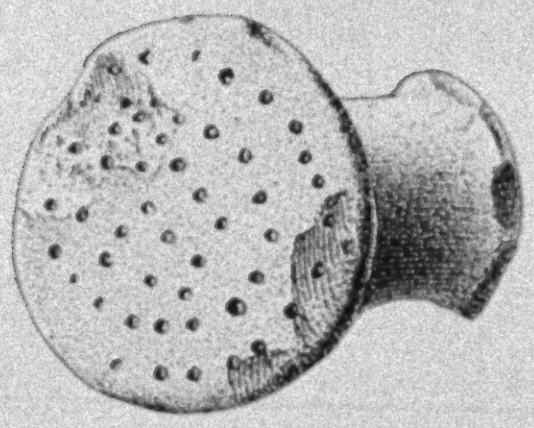
About 1620 an account of the antiquities of Peru was written by an Indian, a descendant of the Incas, whose great-grandparents were living at the time of the Spanish conquest, 80 years before he wrote his account. The original manuscript is in the National Library at Madrid. It is valuable because it gives in traditional form the history of the Incas as it was handed down at the time of the conquest to the grandchildren of the former rulers of Peru.

AN ACCOUNT OF THE INCAS

The account begins as follows:

"I, Don Juan de Santa Cruz Pachacuti-yamqui Salcamayhua, a Christian by the grace of God our Lord, am a native of the towns of Santiago of Hanalucayhua and Hurinhuayhuacanchi of Urco-suyu, between Canas and Canches of Colla-suyu, legitimate son of Don Diego Felipe Condorcanqui and of Doña Maria Huay-rotari, legitimate grandson of Don Balta-sar Cacyaquivi and of Don Francisco Yamquihuanacu (whose wives, my grand-mothers, are alive), great-grandson of Don Gaspar Apuquiricanqui, and of Gen-eral Don Juan Apu Ynca Mayhua, great-great-grandson of Don Bernabe Apu-hilas Urcumi the less, and of Don Gonzalo Pizarro Tintaya, and of Don Carlos Anco, all once principal chiefs in the said prov-ince, and professed Christians in the things of our holy Catholic faith. They were the first chiefs who came to the tambo of Caxamarca to be made Chris-tians, renouncing all the errors, rites, and ceremonies of the time of heathenry, which were devised by the ancient ene-mies of the human race, namely, the demons and devils."

In this Indian's description of the founding of the Inca kingdom he relates the usual stories of the rise of Manco Ccapac, who, when he had grown to "man's estate, assembled his people to see what power he had to prosecute the new conquests which he meditated. Find-ing some difficulties, he agreed with his



A TERRA-COTTA EAR PLUG WITH SMALL HOLES IN WHICH POSSIBLY LITTLE FEATHERS HAD ONCE BEEN PLACED

The Inca nobles were distinguished by the large size of their ear-rings, to receive which the lobe of the ear had been punctured and stretched. This was so conspicuous that the Spanish Conquerors gave the Inca nobles the title of *orejones*, or "big ears." 1¼ times natural size.

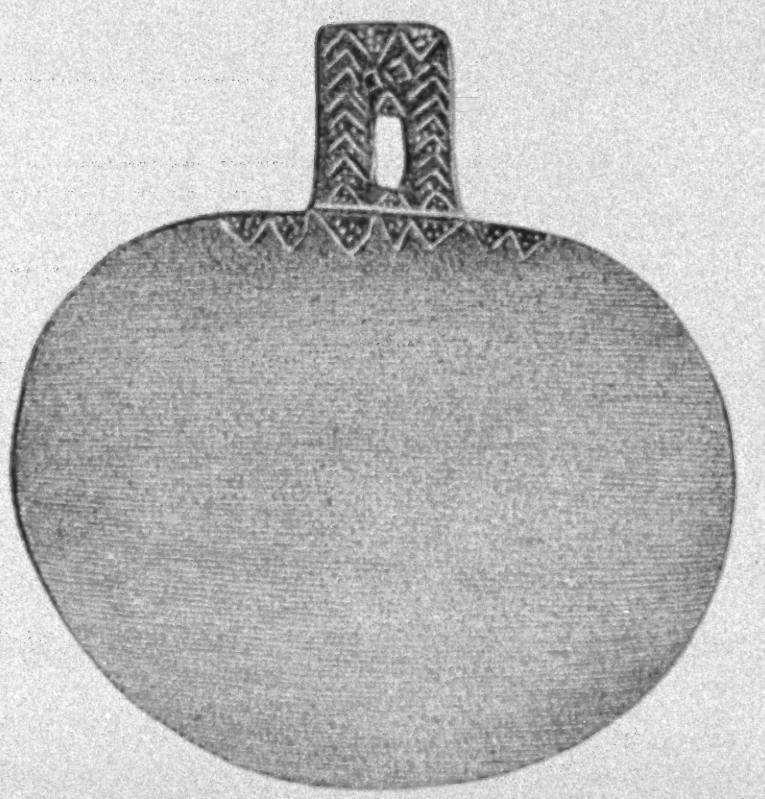
brothers to seek new lands, taking his rich clothes and arms and the staff which had been left by Tonapa. This staff was called Tupac-yauri. He also had two golden cups from which Tonapa had drunk, called Tupac-usi. Thus he set out, with his brothers, toward the hill over which the sun rose." From Machu Picchu that would be up the Urubamba Valley toward Cuzco.

MARRIED HIS SISTER

After reaching Cuzco and settling there, this Inca, Apu Manco Ccapac, married one of his own sisters, named Mama Ocllo, this marriage being celebrated that they might have no equal, and that they might not lose caste. Then they began to enact good laws for the government of their people, conquering many prov-inces and nations of those that were disobedient.

The Ttahuantin-suyus, ancient name for the Peruvians of the Andes, came with a good grace and with rich presents. The tidings of a new Inca had spread widely. Some were joyful, others were afflicted, when they heard that the Inca was the most powerful chief, the most valiant, and the most fortunate in arms; that his captains and men of valor were better armed than other men, and that all his affairs were prosperous.

"Afterward he ordered works to be



A SMALL BRONZE MIRROR, SOMEWHAT RESEMBLING IN FORM THE MIRROR OF THE ANCIENT EGYPTIANS

Found at Machu Picchu. Natural size

executed at the place of his birth, consisting of a masonry wall with three windows, which were emblems of the house of his fathers whence he descended. The first window was called Tampu-toco, the second Maras-toco, and the third Sutic-toco, referring to his uncles and paternal and maternal grandparents." *

So far as we have been able to find out, there is no place in Peru or Bolivia where the ruins consist of "a masonry wall with three windows" *except* at Machu Picchu.

This is the only one of the ancient accounts of Inca history that gives the tradition of Manco Ccapac ordering such a wall to be built at the place of his birth. But the other ancient chroniclers nearly all give the story of this first Inca king coming from a place called Tampu-tocco, or Window Tavern, or Place of Temporary Abode Characterized by Windows. To be sure, most of them assign the location of Tampu-tocco to Paccari-tampu, or Tavern of the Dawn—a small, unimportant village, with an insignificant ruin, southwest of Cuzco. But there are no windows in this ruin, and the natural surroundings of Paccari-tampu do not lend themselves to the other requirements of the story, as was pointed out in the NATIONAL GEOGRAPHIC MAGAZINE for April, 1913, pages 413-414.

Other important references to the former home of Manco, the first Inca, are found in the results of the Viceroy Francisco de Toledo's investigations in 1572, when Tupac Amaru, the last Inca, was put to death.

TESTIMONY OF THE INDIANS

On the 21st day of January, 1572, 15 Indians, who were descended from the Guallas Indians who used to live near the salt terraces near Cuzco, and who said that their ancestors had lived here long before any Incas came to the site where at present is the city of Cuzco, on being questioned all together and individually, said they had heard their fathers and ancestors say that Manco Ccapac came from Tampu-tocco, lived on the site of Cuzco, and began to oppress their ancestors and take their lands away from them.

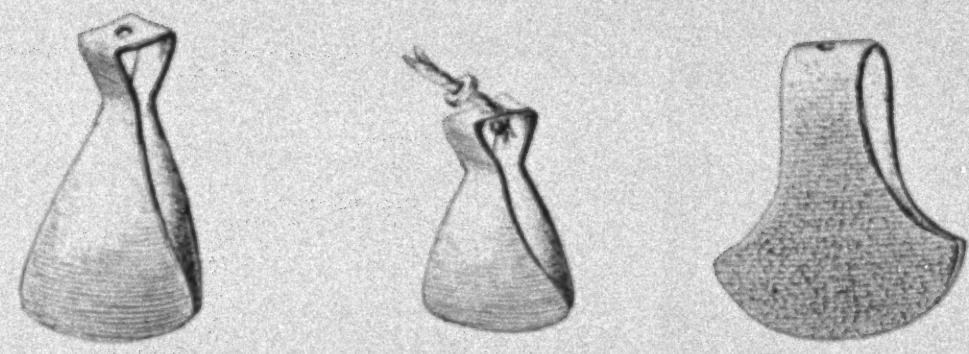
It seems to me significant that they did *not* say that Manco Ccapac came from Paccari-tampu, which would have been a natural thing for them to say, if true, as that was a well-known village in 1572.

Furthermore, in 1570, at a legal investigation made in Xauxa, one of the witnesses, who was 95 years old, said that Manco Ccapac, being lord of the town where he was born, had conquered little by little as far as Cuzco, but he did not know, nor did he remember, nor had he heard, what town was that of Manco. Evidently he was trained to keep the secret.

An Indian chief who followed him in testifying was 94 years old, and confirmed what had previously been stated, but said that he did not know where Manco Ccapac was born, although he knew he was the first Inca. Another Indian-chief witness, who was aged 92 or 93, said that Manco Ccapac came out of a cave called Tuco or Tocco; that he was lord of the town near that cave, and that he was the first of the Incas.

These investigations also were made during the reign of the Viceroy Toledo. In these legal examinations it is not once stated by an Indian under oath that Manco Ccapac came from Paccari-tampu, although it is difficult to imagine why

* Quoted from Sir Clements Markham's translation.



BRONZE TWEEZERS FOR EXTRACTING HAIR FOUND AT MACHU PICCHU. ALL 1¼ TIMES NATURAL SIZE

they should have overlooked that fact if, as the Spaniards believed, it was a fact.

I still feel that the ancient home of Manco Ccapac, which might be termed the cradle of the Incas, was not located at Paccari-tampu.

THE CRADLE OF THE INCAS

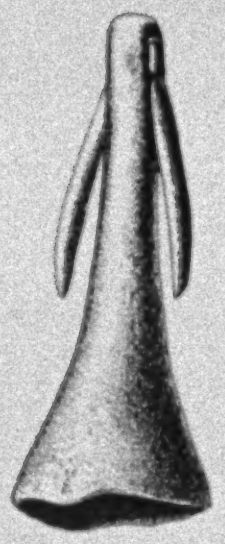
Whether or not it was located at Machu Picchu is another question.

I believe it was, for the following reasons:

Firstly, the requirements of Tampu-tocco as described in Montesinos are met at Machu Picchu and *not* at Paccari-tampu. The splendid natural defenses of the region around Machu Picchu made it an ideal refuge for the descendants of the megalithic folk in the five or six hundred years of anarchy that succeeded the barbarian invasions from the plains to the east and south, while at Paccari-tampu there is marked lack of natural defenses; the scarcity of violent earthquakes at Machu Picchu, and also its healthfulness, are both marked characteristics of Tampu-tocco, and here we find record stones and other pre-Inca material.

Secondly, because the distinct tradition recorded by the Indian Salcamayhua refers to the construction of a masonry wall with three windows at the place of Manco Ccapac's birth, and the first window was called Tampu-tocco; and at Machu Picchu we have what is clearly a ceremonial building, which may be described as a masonry wall with three windows, while at Paccari-tampu there are no such windows.

Thirdly, the early witnesses when asked, under oath, to tell where Tampu-tocco was, all dodged the question. None of them, however, declared it was at Paccari-tampu.



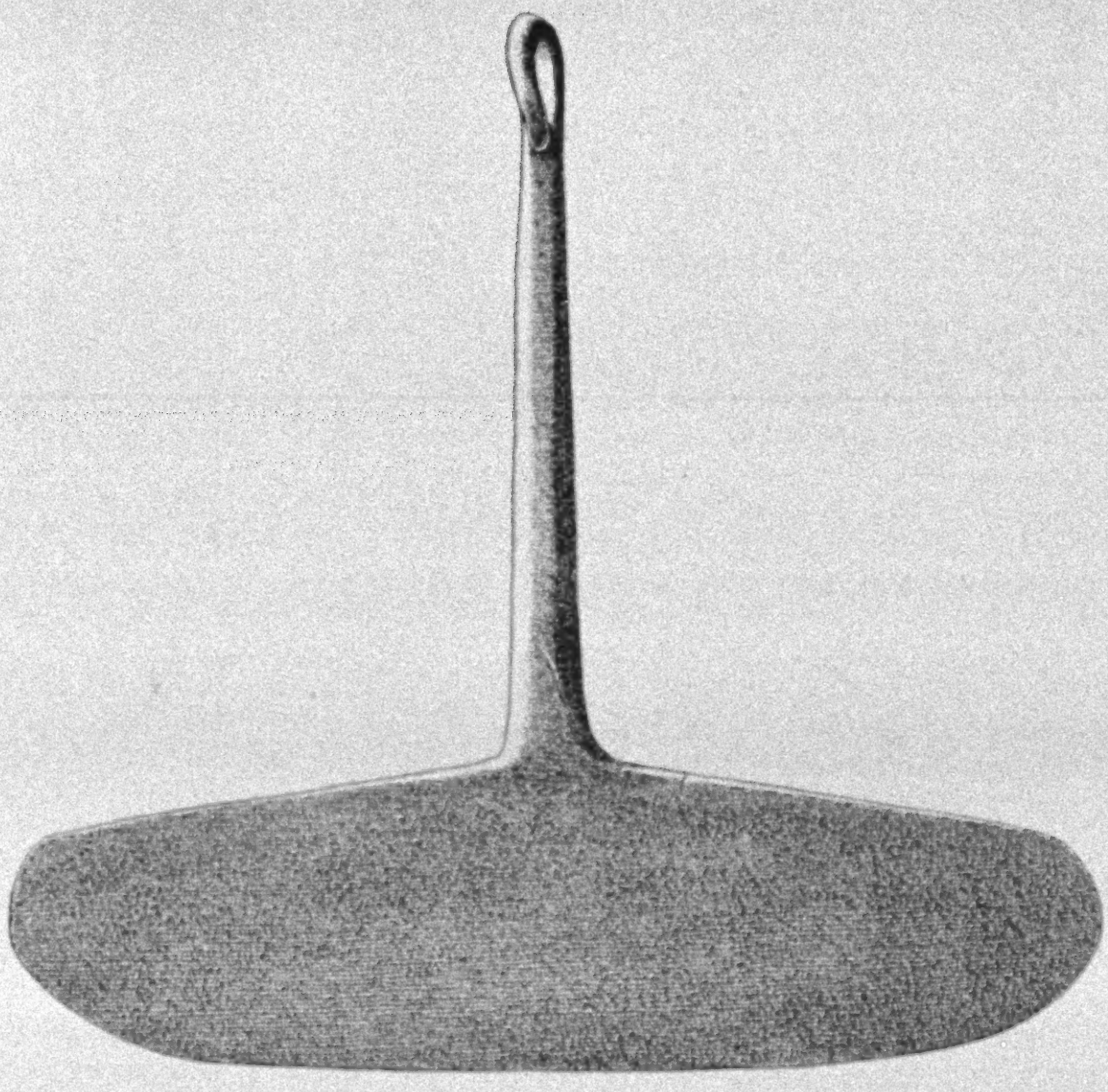
A BRONZE PENDANT OR EAR-RING

THE SACRED VIRGINS OF THE SUN

All these facts lead me to the belief that the original name of Machu Picchu was Tampu-tocco; that here the last megalithic king was buried, and that it was the capital of the little kingdom of his descendants during eight of ten centuries between the megalithic era and the Incas; that it was probably the birthplace of Manco Ccapac, and after he had achieved greatness he built a fine temple and palace here.

There is so little convenient arable land near Machu Picchu that when the people who occupied it once got control again of Cuzco and the rich valleys in that vicinity, there was no necessity for them to maintain a city at this spot under great difficulties. The original city may have been very small; but it was natually a sacred place, and its whereabouts were undoubtedly known to the priests and those who preserved the most sacred and secret traditions of the Incas. It *may* have been practically deserted for 300 years while the Inca Empire grew and flourished and its location entirely forgotten by the common people.

Then came the Spaniards, and, with their conquest, the necessity of saving what was possible of the ancient religion. The most precious objects were not the gold and silver images that the Spaniards craved, but the sacred Virgins of the Sun, who from their earliest childhood had been educated to the service of the temple and to ministering to the wants of the Inca. Some of these were undoubtedly captured, but many appear to have escaped. They naturally went



A BRONZE KNIFE OF THE MORE ORDINARY PATTERN FOUND AT MACHU PICCHU.
NATURAL SIZE

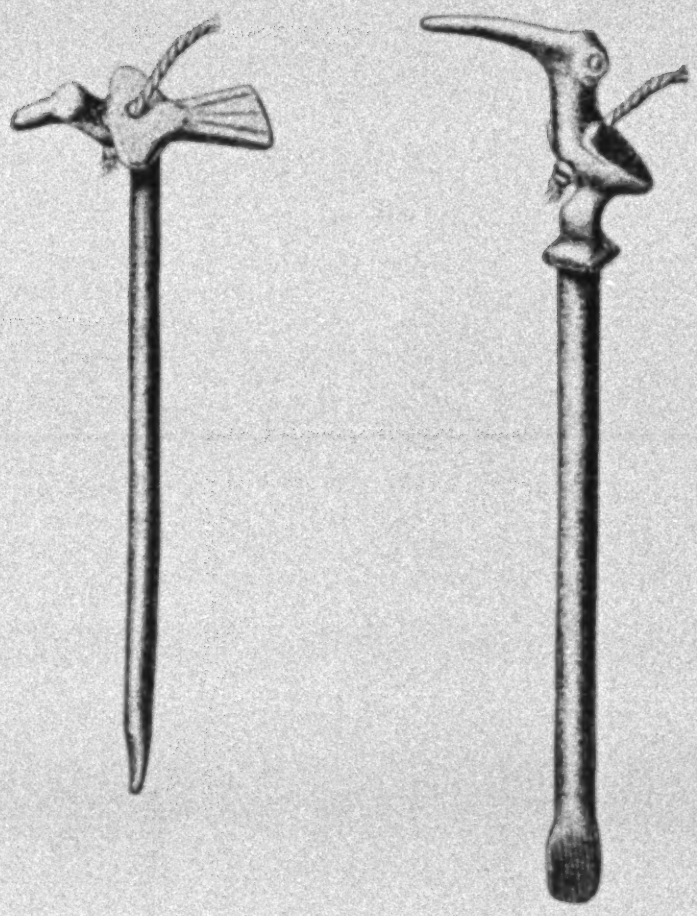
with the Inca, the young Manco, who had been set up by Pizarro to be a dummy Inca, but who rebelled and fled into the wilds of Vilcabamba.

FLED FROM THE CONQUERORS

He set up his own capital at Vitcos, where, as we were able to demonstrate in 1911, he was near an ancient shrine—a great white rock near a spring of water. Here he was surrounded by fertile valleys, at the same time difficult of access. He was, however, not too far removed from the great highway which the Spaniards had to use for their caravans in passing from Cuzco to Lima, so that he could readily attack them.

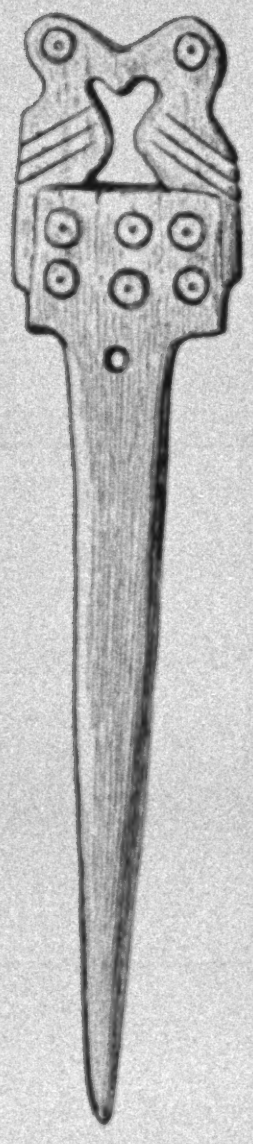
The only possible reference I can find to these Virgins of the Sun, or, as they have been called, Concubines of the Inca, is in the missionary chronicles of Father Calancha, an Augustinian. He relates the trials of two monks who, at the peril of their lives, entered the sequestered valleys near Vitcos and, after founding a convent at Puquiura, near Vitcos, asked the Inca to let them visit "Vilcabamba the Old." For a long time he refused; but finally he yielded to their urgent request and bade them prepare for the journey.

Calancha says that the Inca took the monks, with a small company of his captains and chieftains, over a very rough road. The Inca did not suffer, because he was carried in a litter, but the monks had to walk, and their robes hindered them. They arrived at a bad place in the road, called *Ungacacha*, where the trail was under water, as the river had risen. The monks thought it was as bad as being asked to wade through a lake. The water was very cold. But, because they so much desired to go to Vilcabamba to preach, "on account of its being the largest city, in which was the university of



SMALL BRONZE SPOONS WITH DECORATED HANDLES

They were probably intended for use in supplying the small quantity of lime needed in connection with chewing coca leaves. Found at Machu Picchu. 1¼ times natural size.



BONE NEEDLE, PROBABLY OF INCA ORIGIN, FOUND AT MACHU PICCHU

the idolatry, where lived the teachers who were wizards and masters of abomination," they persevered.

The followers of the Inca were much amused at the attempts of the monks to wade along the inundated trail, but the Fathers kept up their courage and helped each other through the water as best they might.

THE PRIESTS ARE TEMPTED

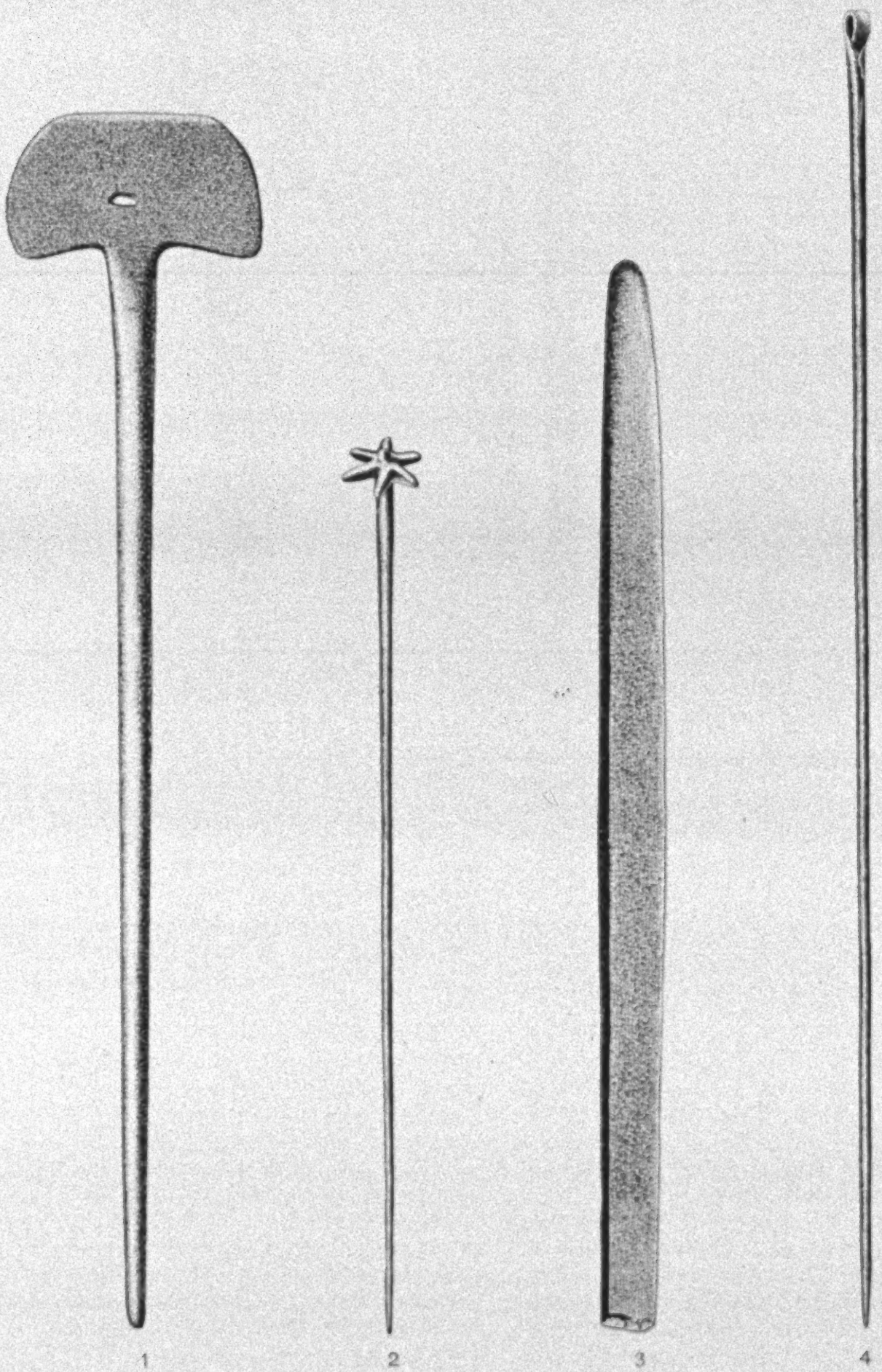
After a three days' journey over rough country, they arrived at Vilcabamba the Old. We know that Machu Picchu may be reached in a three days' journey over a rough road from Puquiura.

Calancha says that the Inca, unwilling that the Fathers should live in the city, ordered that they be given a dwelling outside, so that they might not witness the ceremonies and ancient rites which were practiced by the Inca and his captains and priests.

Nothing is said about the appearance of the city, and it is doubtful whether the monks were allowed to enter the gates or to know exactly where the city was located. They were bothered and tormented in various ways. Nevertheless they kept preaching and teaching during the three weeks of their stay in this vicinity, until they felt that it was time they got back to Puquiura, where they had established a mission school.

During their stay Calancha relates that the Inca used every means in his power to tempt and try the monks and to endeavor to make them break their vows of celibacy. After consultation with his priests and soothsayers, the Inca selected (says Calancha) some of the most beautiful Indian women not only of the mountainous districts, but from the tribes of the *coast valleys*, who were more attractive than those of the mountains.

It is evident from the chronicle that in the town of Vilcabamba the Old there were a considerable number of women and some priests. It is also evident that Vilcabamba the Old was so constructed that the monks could be kept in the



1 2 3 4

(1) A copper knife-edge shawl pin, a convenient utensil worn by Inca women. Natural size. (2) Bronze shawl pin with star-pointed head. .4 natural size. (3) Bronze crowbar. 1/3 natural size. (4) Bronze needle. .44 natural size. All these interesting souvenirs of a departed race were found at Machu Picchu.

A BRONZE AXE OF THE TYPE USED BY THE INCAS IN SOME OF THEIR RELIGIOUS CEREMONIES, FOUND AT MACHU PICCHU. NATURAL SIZE

vicinity without being able to see what was going on in the city.

MACHU PICCHU FITS THE PICTURE

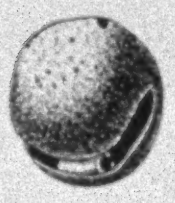
So far as this latter condition is concerned, Machu Picchu admirably answers the requirements of the case, for it would have been very easy for the Inca to have kept the monks in the vicinity of Machu Picchu for three weeks without their having a single glimpse of the extent or beauty of this ancient city. Had they been lodged in huts at the foot of the mountain, only two hours' journey from the city, the requirements of the chronicle might easily have been met. The monks probably knew so little of the extent or remarkable character of the place near which they lodged that no account of it could have been given to their friends and eventually reported by Calancha. Furthermore, as has been said, Machu Picchu is just about three days' journey on foot from Puquiura, so that this requirement is also met.

The question remains: Is there any evidence that the last residents of Machu Picchu were priests and Virgins of the Sun or women of the coast valleys?

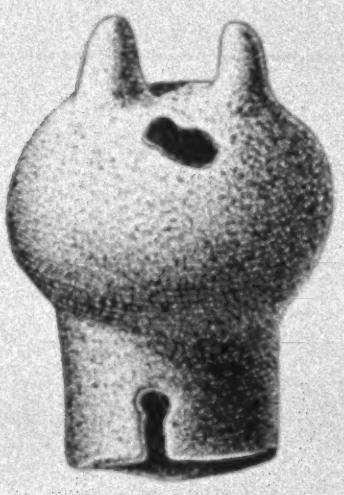
Fortunately, Dr. George Eaton, of the Peabody Museum of Yale University, under whose direction a large amount of skeletal material was collected in 1912 from the burial caves at Machu Picchu, and who has been making a careful study of this material during the past year, has come to the conclusion that among the skeletons there is not a single one of a robust male of the warrior type. There are a few effeminate males who might very well have been priests, but the large majority of the skeletons are female and *some are coast types.*

A "UNIVERSITY OF IDOLATRY"

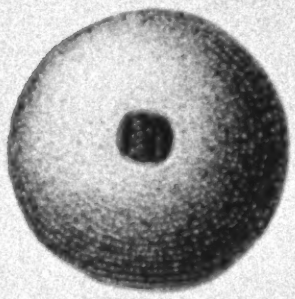
Until we can find some other ruin within three days' hard journey of Puquiura which answers the requirements of a "university of idolatry," an important religious center, containing mostly



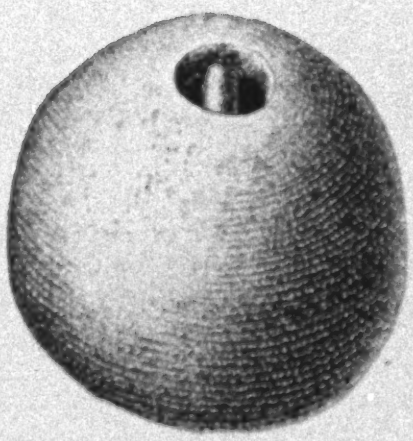
A TINY BRONZE BELL



A SMALL BRONZE BELL



A BRONZE PLUMBOB



A SILVER PLUMBOB

All these objects, found at Machu Picchu, are pictured 1¼ times natural size

remains of women and effeminate men, I am inclined to believe that we have at Machu Picchu the Vilcabamba-the-Old of Calancha's chronicle.

Now the question remains, Does the archeological evidence tend to support or destroy this theory?

In the caves where the skeletal material was found we secured a large number of broken pieces of pottery and a few that were not broken. These are shown on pages 210-214. They are of the type usually called *the Cuzco style* and accepted as the sort of pottery commonly used *by the Incas*. In the excavations in the older part of the city itself fragments of other types were found, represented by the brazier on page 206, which appear to belong to an earlier culture than the Inca.

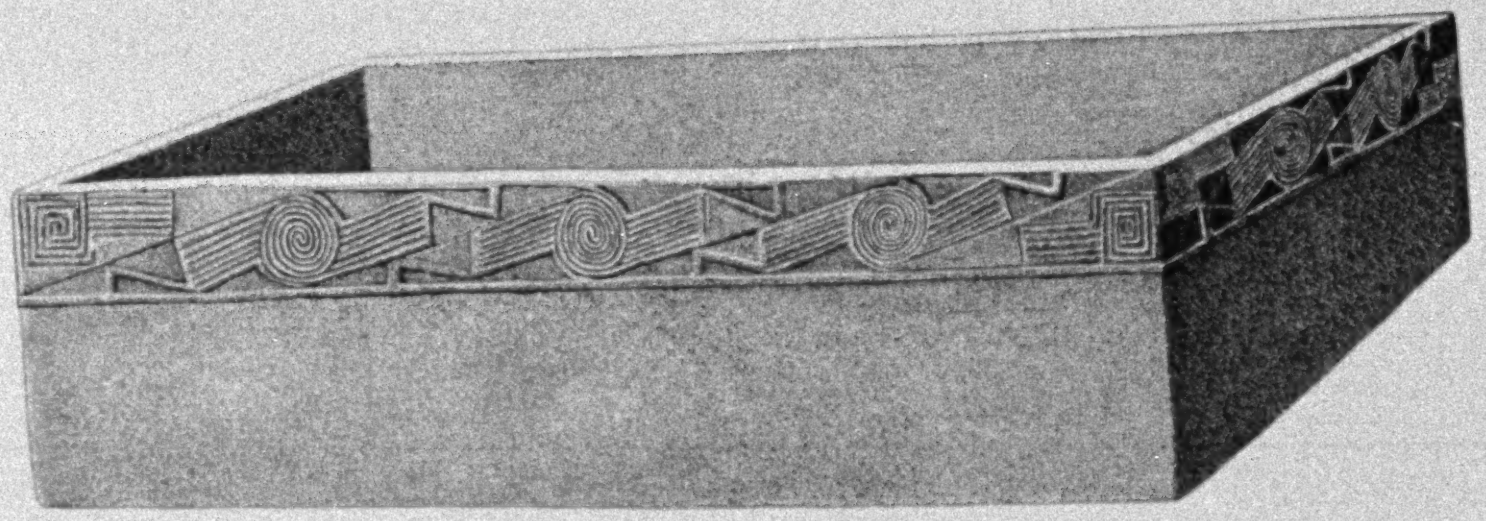
In addition to the evidence of the pottery, we have the evidence of the buildings, which clearly appear to have been built in two distinct periods. Some of the photographs in my previous article (April, 1913) give abundant evidence to even the most casual observer of the fact that the lower portion is of finer construction than the upper.

Examination of the ruins of the fairly recent Inca cities on the islands of Lake Titicaca, where few of the structures are earlier than 1300 A. D., and of the ruins of the palace of Vitcos, a palace built probably about 1540, shows that the Incas in their later construction used a considerable amount of clay and mud in filling in the chinks of the walls, thus obviating the necessity of laboriously shaping the stone blocks with anything like the precision used by their distant ancestors, the megalithic folk. Several pictures of houses at Machu Picchu appearing in my previous article show ancient terrace walls, on which are built typical Inca houses.

A SUMMARY OF EVIDENCE

Is it possible that at Machu Picchu we have the ruins of Tampu-tocco, the "cradle of the Incas," the birthplace of Manco Ccapac, the first Inca; and *also* the ruins of Vilcabamba-the-Old, the sacred city of one of the last Incas and the home of his women and priests?

Let us take into consideration the following facts: *First*, in the buildings and walls of Machu Picchu we have two



A BEAUTIFULLY DECORATED STONE DISK, CARVED OUT OF A SINGLE PIECE OF STONE

Found in many pieces widely scattered over the ridge near the Snake Rock and the Three Window Temple, undoubtedly pre-Inca and possibly a remnant of the earliest folk who built the pre-Inca structures at Machu Picchu. 1/3 natural size.

distinct styles, probably separated several centuries in development—an early period when the city was small and the structures remarkably fine (one of the finest of which is a masonry wall containing three large windows), and a second period when the structures are of late Inca design, and many of them built on top of ancient terraces and ancient walls; *second*, in the pottery we likewise have, in the more recent burial caves, Inca-style pottery, and in the excavations in the more ancient part of the city different and earlier types of pottery; *third*, in the more ancient part of the city, near the Sacred Plaza and the Snake Rock, we find a large number of problematical stone objects or "record stones" not found in the burial caves with the Inca pottery, and whose use does not appear to have been known to the Incas.

Finally, if we add to these facts the skeletal evidence, and remember that the bones of the most ancient inhabitants and the builders of the town have probably long since disappeared, and that the remains found in good condition in the burial caves must be those of the more recent inhabitants, and remember that these turn out to be chiefly the skeletons of women, some of whom are pronounced to be of the coast types, we are ready to arrive at the conclusion that Machu Picchu has had two periods of occupancy, and in its last state is probably the place referred to by Calancha as "Vilcabamba the Old," where the Inca treasured the remains of his religion, restored the University of Idolatry, and kept the Virgins of the Sun who had escaped from the ravages of the Spanish Conquerors.

An examination of the walls of the houses shows that the town was enlarged by the Incas to accommodate its increased population. An examination of the results of excavation shows that the three-windowed temple and its vicinity belonged to a far earlier period than the east part of the city and the burial caves, in short probably to the end of the megalithic period.

ABUNDANT CONFIRMATION

The archeological evidence (the artifacts, the pottery, and the bones), combined with the historical evidence in the incidents brought out by Montesinos, Salcamayhua, and Calancha, besides the testimony of the old men who gave their evidence in the time of the Viceroy Francisco de Toledo, confirms us in the belief that at Machu Picchu we have the ruins of Tampu-tocco and, superimposed on them, the ruins of Vilcabamba the Old.

Surely Machu Picchu, which has made such a strong appeal to us on account of its striking beauty and the grandeur of its surroundings, appears to have had a most interesting history. Selected as the place of refuge for the last of the megalithic kings; chosen as the site for the capital of the little kingdom which their followers set up, and where they reigned for six or seven hundred years; abandoned when Cuzco once more flashed into glory as the capital of the great Inca Empire, it was again sought out in time of trouble when the foreign invader

desired to extinguish all vestiges of the ancient religion, and became the home and refuge of the Virgins of the Sun, whose lives and whose institution formed one of the most interesting features of the purest religion of aboriginal America.

Concealed in a cañon of remarkable grandeur, protected also by walls and a moat, these chosen women gradually passed away on this beautiful mountain top and left no descendants willing to reveal the importance and explain the significance of the ruins of Machu Picchu.

Finally, a word of caution: it must be remembered that there are no inscriptions at Machu Picchu to enable us to be sure of our deductions. The evidence is what lawyers term circumstantial; but it must stand until some one can find a place or places better suited to answer the requirements of *Tampu-tocco*, home of Manco Ccapac, the First Inca, and *Vilcabamba the Old*, religious capital of Manco, the Last Inca.

In the following pages I have endeavored to give a more special study of the so-called "record stones," which seem to be pre-Inca and may have been used to keep the records at Tampu-tocco before the discovery of the *quipu*, or knotted string.

QUEER RECORD STONES

During the progress of the work carried on at Machu Picchu in 1912, the most fruitful digging was that on the ridge between the Temple of the Three Windows and the city gate. The most interesting feature of this part of the city is a huge boulder with several snakes carved on its upper surface. We called it Snake Rock (see page 497, April, 1913).

In these excavations we found large quantities of curiously shaped stones of a type *not* used by the Incas, so far as we know. Their character is well brought out in the drawings shown on page 204. Many of them are made of a green micaceous or chloritic slaty schist. They were probably quarried at the foot of one of the precipices on Machu Picchu Mountain. Their use is largely problematical.

In some ways they are one of the most interesting features of the collections. It is possible that they are record stones. A few similar ones were found by Professor Saville in Ecuador, and Dr. Dorsey found similar ones on the Island of La Plata, off the coast of Ecuador. An eminent Peruvian archeologist, Señor Gonzalez de la Rosa, believed that the pre-Incas kept their accounts in record stones, just as the Incas used *quipus*, a series of different colored and diversely knotted strings. Professor Saville, in his "Antiquities of Manabi, Ecuador," has the following to say in regard to these:

"We quote herewith from Velasco, the source which has undoubtedly served Mr. de la Rosa in coming to his conclusion. In the 'Historia Antigua del Reino de Quito,' by Velasco, he states that he obtained his information from the work of Fray Marcos de Niza, whose history, he says, is the only fountain of information which merits confidence. Unfortunately, we know of this work only through the extracts which have been quoted by Velasco. On page 7, volume 2, Velasco writes:

"'They used a kind of writing more imperfect than that of the Peruvian *quipos*. They reduced it [the writing] to certain archives, deposits made of wood, stone, and clay, with divers separations, in which they arranged little stones of distinct sizes, colors, and angular form, because they were excellent lapidaries. With the different combination of these they perpetuated their doings and formed their count of all.'

"On the same page, in treating of the number of years of the Cara rule of the province of Quito before the coming of the Incas, he continues: 'Some, by their traditions and the deposits of the little stones, extended this to seven hundred years, with the succession of eighteen *scyris;* and others, with the same counts and traditions, only extended it to five hundred years, with the succession of eighteen *scyris.*' These statements clearly show the system to have been imperfect. Again, in treating of the burial customs of the *scyri*, or kings of Quito, Velasco writes, on page 33, as follows (see page 203).

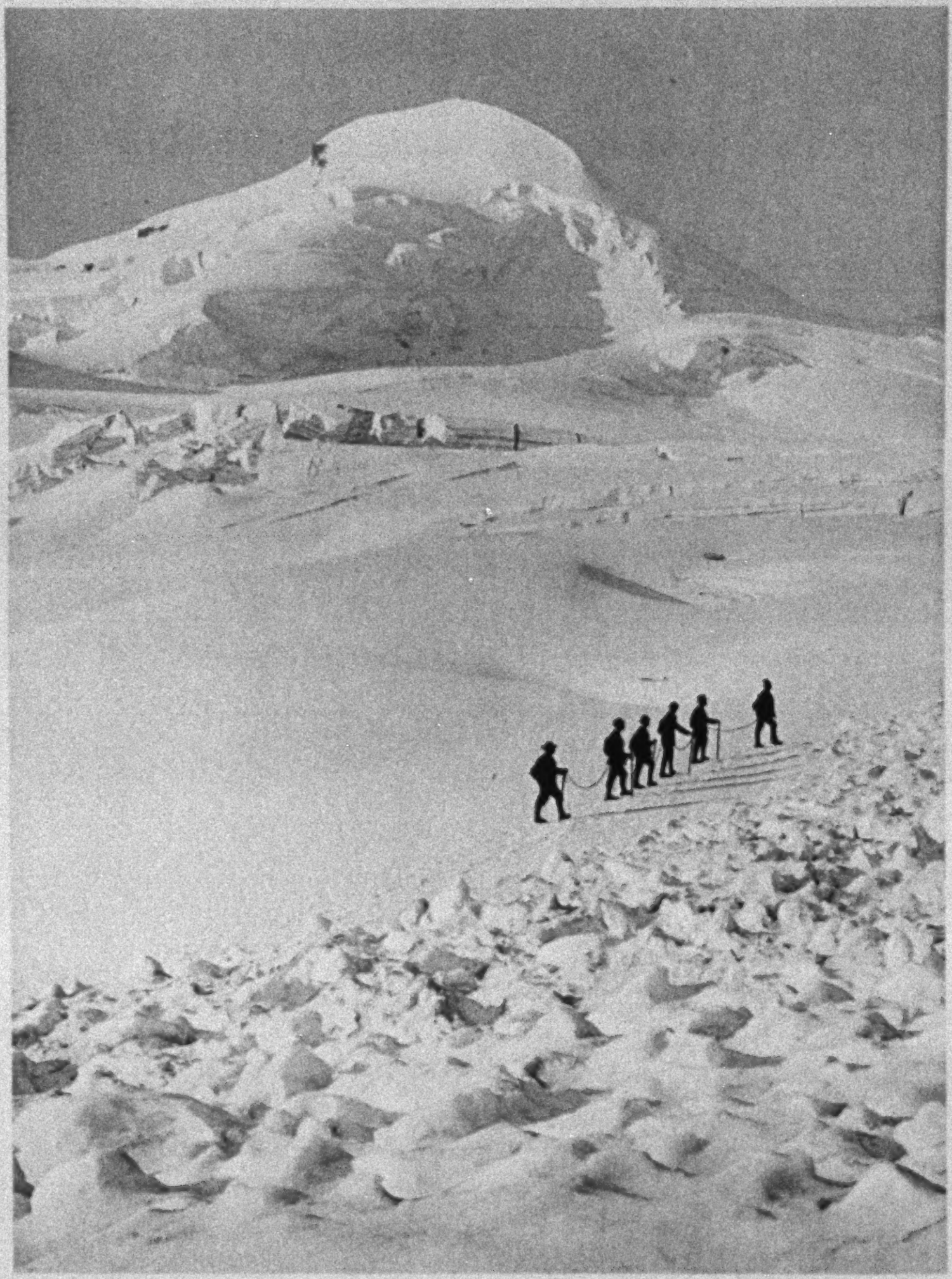


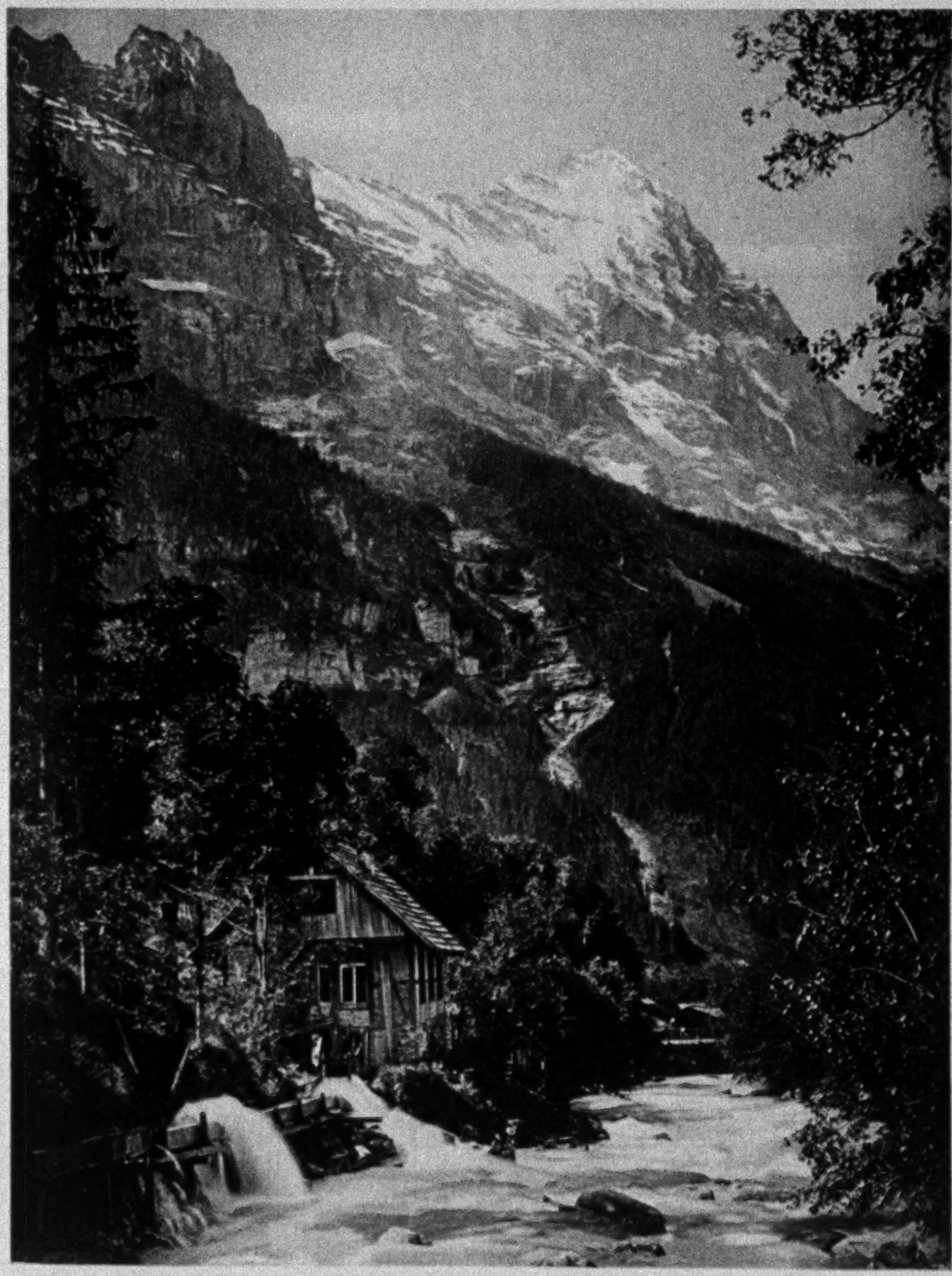
Photo by Donald McLeish

AN ASCENT OF THE ALLALINHORN: SWISS ALPS

The Allalinhorn is a not distant neighbor of the Matterhorn and Mount Blanc, in the Pennine Alps, between the Little St. Bernard and the Simplon Pass.

WHERE MOUNTAINEERING WAS BORN: THE WETTERHORN

Systematic mountaineering, from the standpoint of sport, began when Sir Alfred Wills ascended the Wetterhorn in 1854. The following year the first ascent of Monta Rosa was made and two years later an Alpine club was formed in London, the forerunner of Alpine clubs throughout the world. In 1865 Edward Whymper's ascent of the Matterhorn marked the close of Alpine conquest, and thereafter the mountain climbers turned their attention to the Caucasus and the Selkirks. The exploration of the highest Andes began when Whymper climbed Chimborazo. The Himalayas were the last of the high mountain ranges to be climbed.

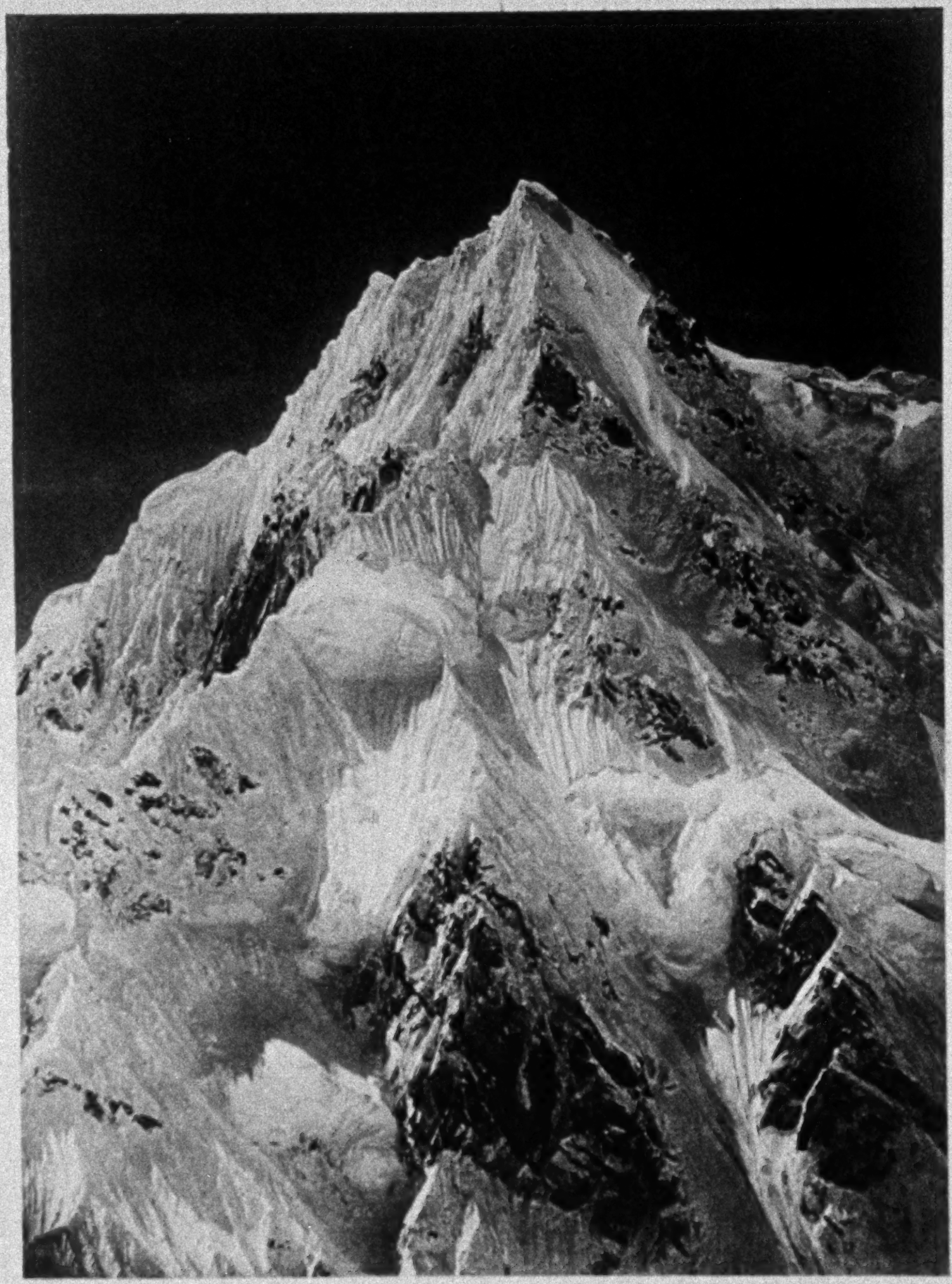


RURAL SCENE IN SWITZERLAND

The Swiss army is organized on a basis of a thorough military training for every citizen, with few exempt from service, and with those exempt taxed in lieu of service. Literary instruction and gymnastics are coupled with military instruction, and every boy reaching military age must enter the service for a period varying from 60 to 90 days.

IN THE FOOTHILL FORESTS OF THE HIMALAYAS

It is from regions such as this that come tens of thousands of India's fighting forces which now stand shoulder to shoulder with the French, English and Belgians, in Belgium and France. The hot, long rainy seasons produce a vegetation unsurpassed in luxuriance, but it has never served to dampen the ardor of the fighting men of India.



Telephoto by Vittorio Sella

THE CREST OF SINIOLCHUM, IN THE HIMALAYAS

This mountain, 23,000 feet high, is generally regarded by mountain lovers the most beautiful of all snow-peaks. It is situated in the Sikkim Himalayas, between the Teesta and Zemu Rivers.

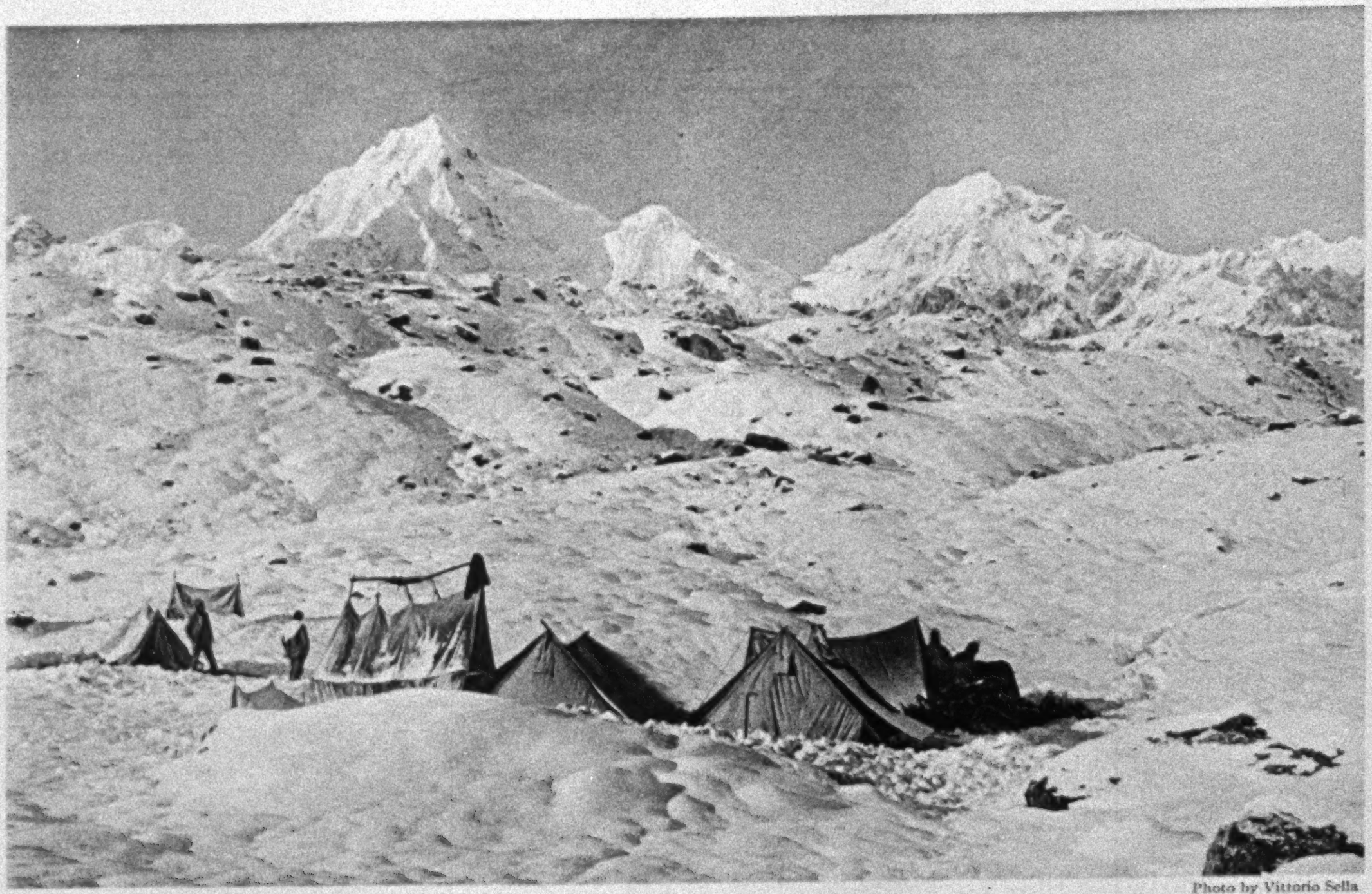


Photo by Vittorio Sella

THE ZEMU GLACIER AND MOUNT SINIOLCHUM

The valleys of the Himalayas present every conceivable variety of climate, vegetation and produce. They contain whole nations with various political organizations; tribes of diverse races and origin, at every stage of civilization, speaking an endless number of different tongues, professing every religion of Asia, exemplifying social customs which range from polygamy to polyandry. It scarcely seems possible that man should ever succeed in completely exploring this forest of peaks. Thousands of them probably reach up to 20,000 feet.

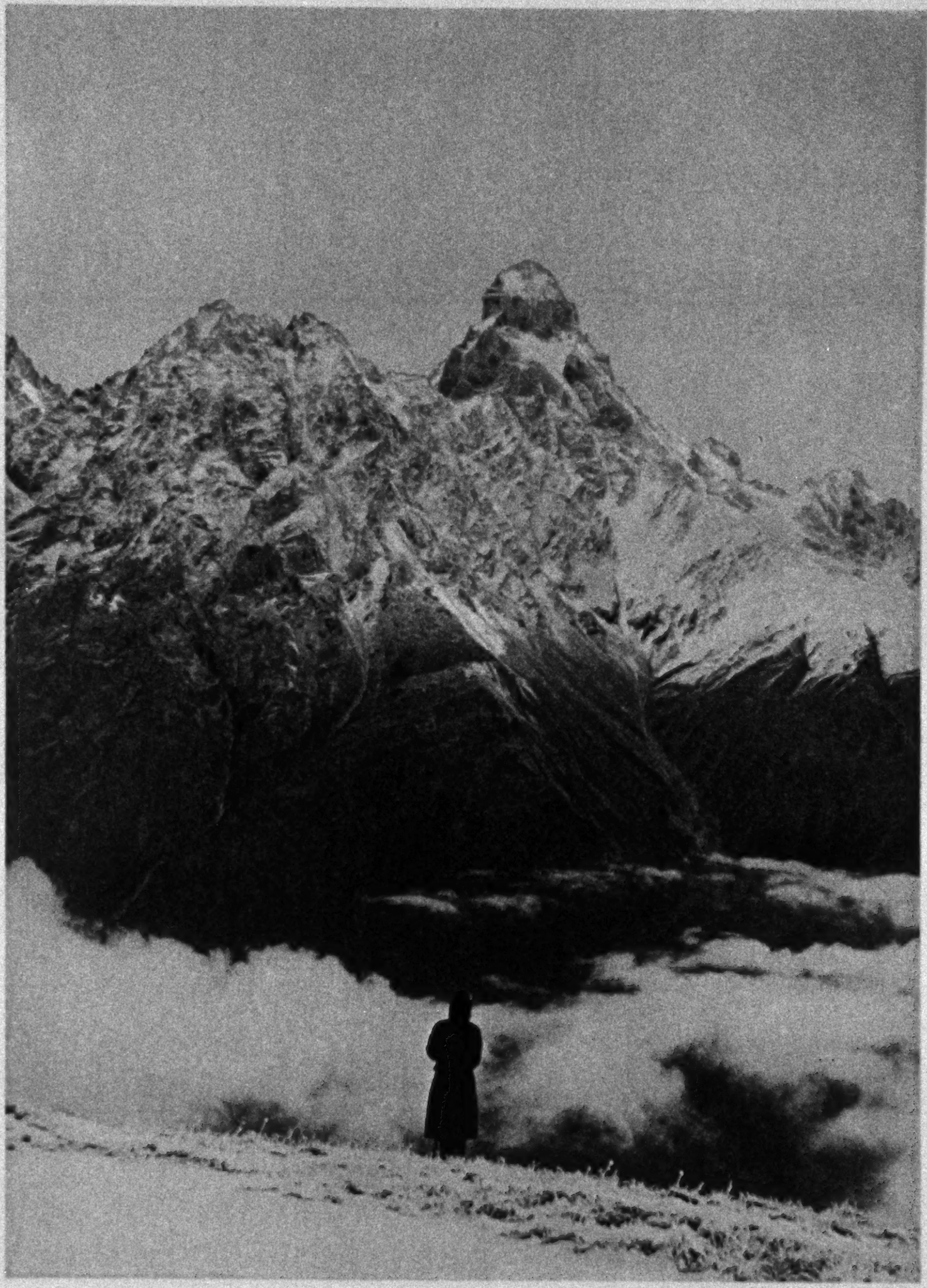


Photo by Vittorio Sella

USHBA, THE MOST IMPRESSIVE OF ALL CAUCASIAN MOUNTAINS

Double-towered Ushba, stationed on the watershed which divides Asia from Europe, gives one of its peaks to the former and the other to the latter. The Caucasus gave to that great race which has ruled the world through many generations its name. Long before the Christian Era, Greek merchants brought back news of rivers running with gold, in which the natives laid sheepskins to enmesh the shining metal. They reported it a land of fertile valleys, where grapes and peaches grew wild, where minerals of every description abounded in inexhaustible quantities, and where the Eldorado of earth existed.

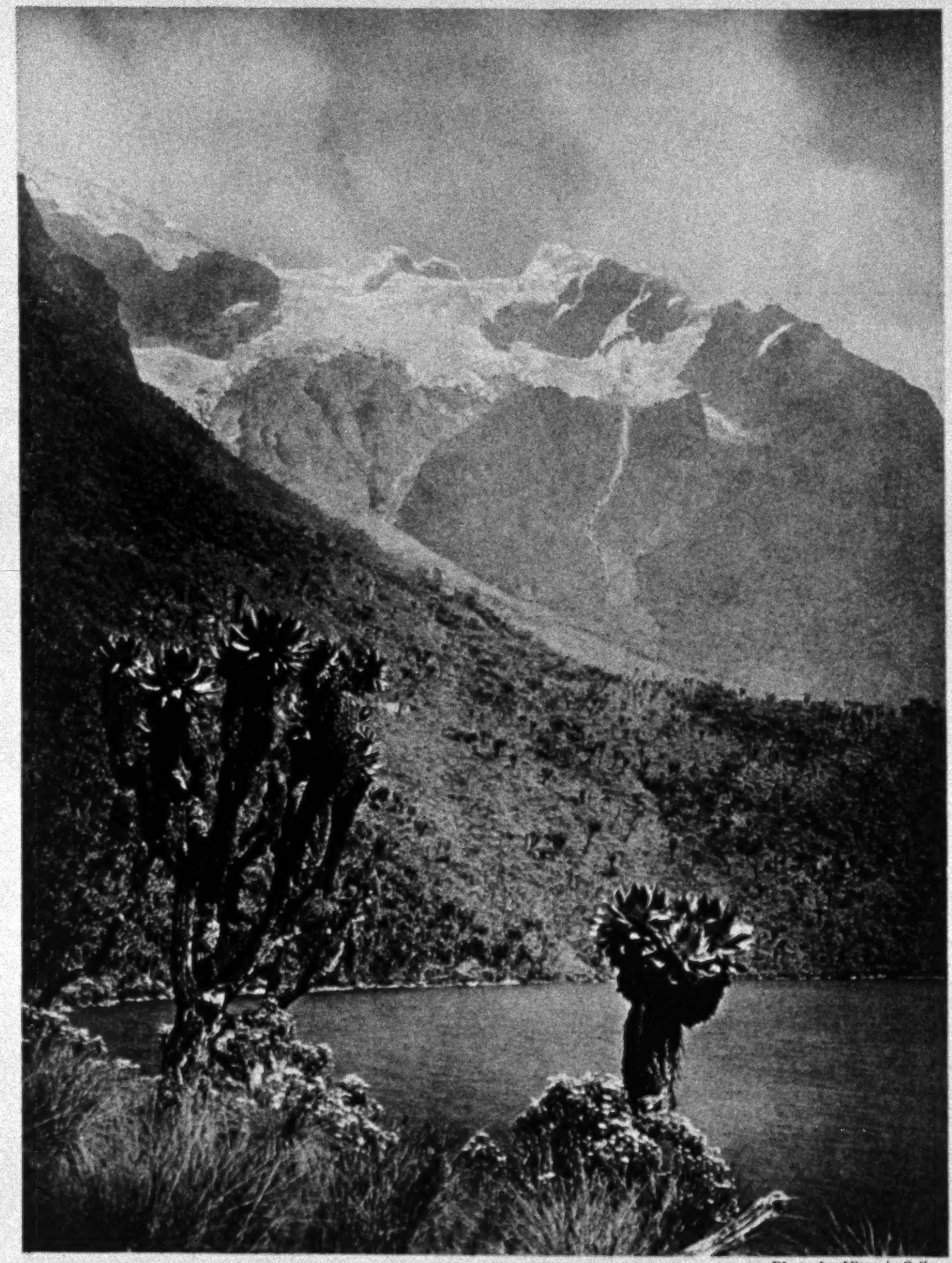


Photo by Vittorio Sella

LAKE BUJUKA AND MOUNT STANLEY

Describing his discovery of the Ruwenzori Mountains, Henry M. Stanley wrote that while looking to the southeast he saw a peculiar-shaped cloud of the most beautiful silver color. Following its form downward he became struck with the deep blue black color of its base; then, as the sight descended to the gap between the eastern and western plateaus, he became conscious that what he gazed upon was not the image or semblance of a vast mountain, but a real one covered with perpetual snow.

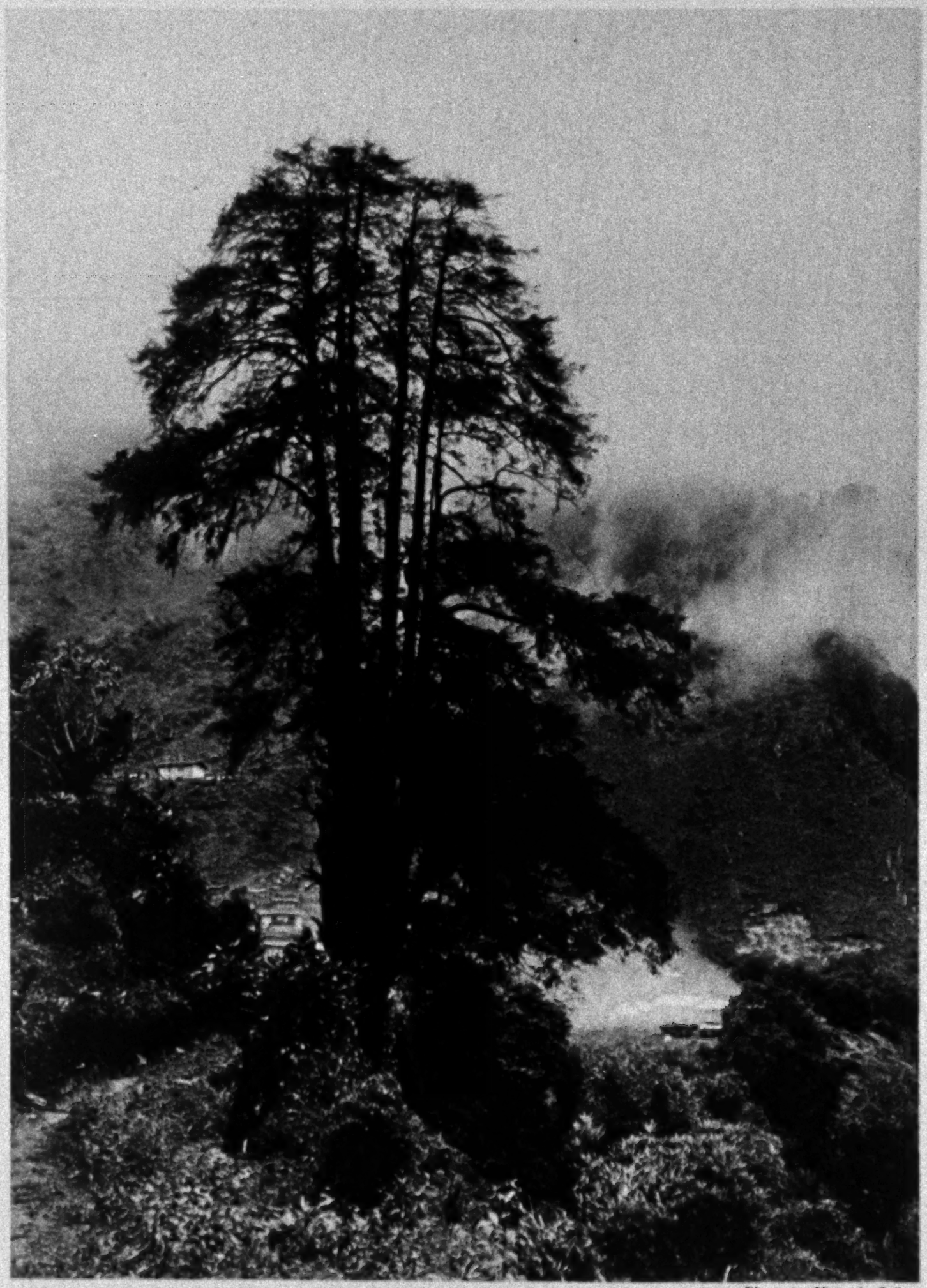


Photo by Vittorio Sella

A BEAUTIFUL VALLEY IN THE HIMALAYAS OF SIKKIM

The valleys which slope up into the mountain passes from Darjeeling into Sikkim are covered with luxuriant forests, which are apparently tropical, even at a great height. Here Alpine plants of marvelous beauty reach dimensions undreamed of in Europe or in the United States. This vegetation is the result of torrents of rain which fall throughout the summer months. Within a territory of less than 3,000 square miles there is found more than 4,000 species of flowering plants, 200 varieties of ferns, 400 kinds of orchids, 20 different bamboos, and 30 types of the rhododendron.

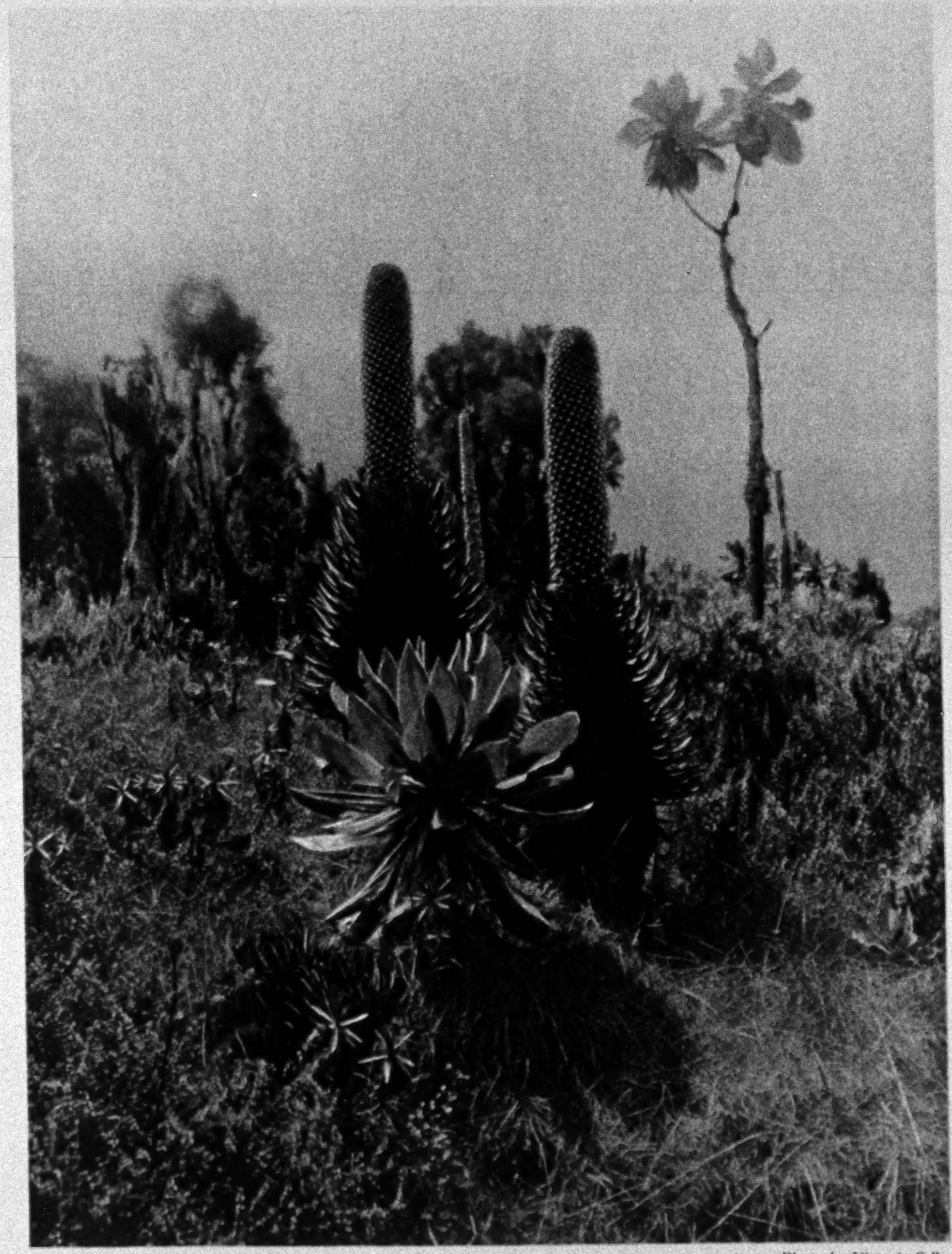


Photo by Vittorio Sella

THE LOBELIA DECKENI, SENECIO AND TREE-HEATH, RUWENZORI MOUNTAINS, AFRICA

The whole valley is one mass of luxuriant vegetation of indescribable strangeness. The ground is carpeted with a deep layer of lycopodium and springy moss, thickly dotted with big clumps of papery flowers, and with pink, yellow, and silver-white "everlasting." Above these rise the tall columnar stocks of the lobelia, like funeral torches, beside huge groups of the monster senecio. The impression produced is beyond words to describe. The spectacle is weird, improbable, and unlike all familiar images.

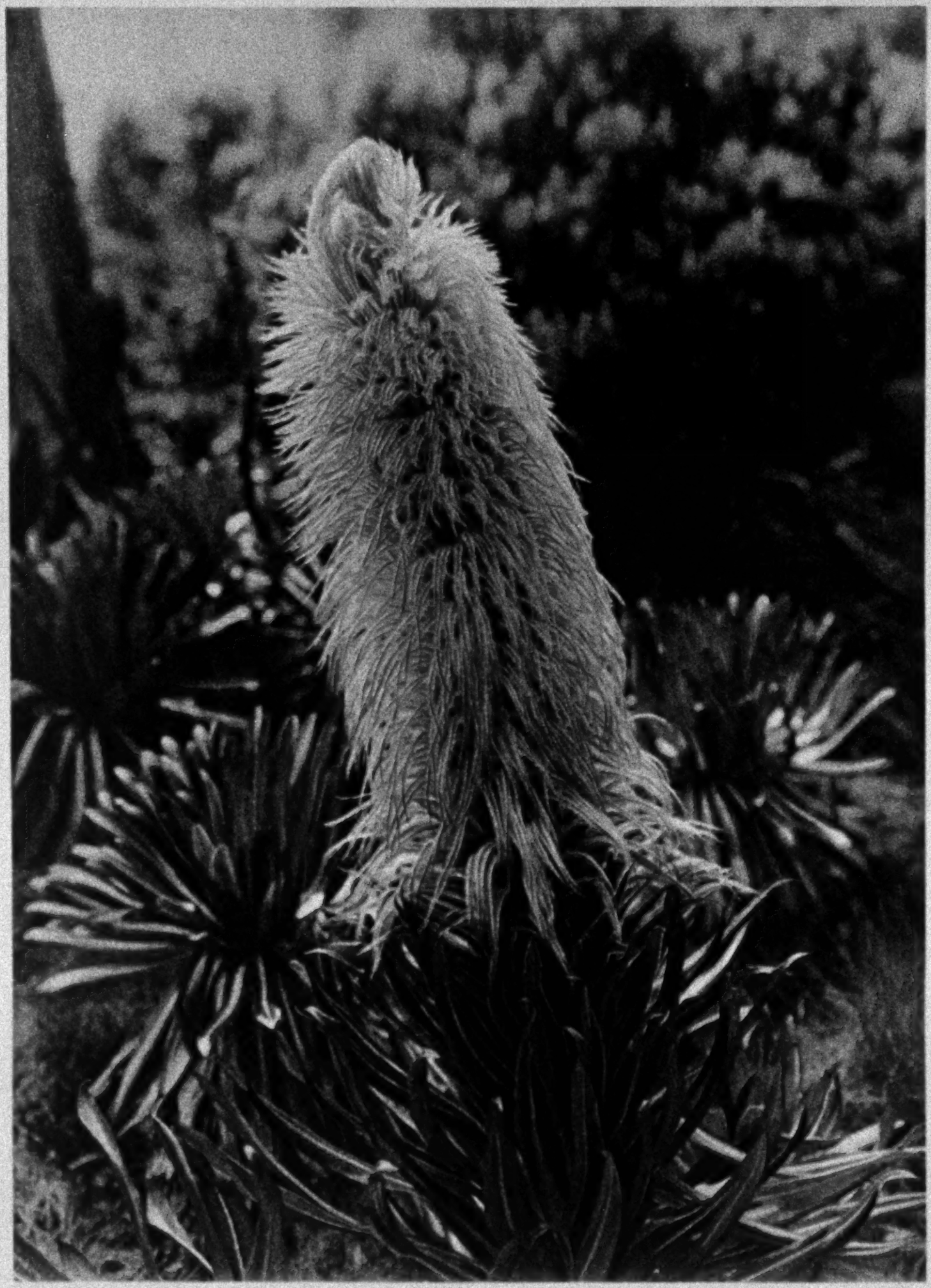


Photo by Vittorio Sella

A GRACEFUL LOBELIA WOLLASTONU IN BLOOM, RUWENZORI MOUNTAINS, AFRICA

This is one of the rarest of the two hundred species of lobelia found in all the temperate and warmer regions of the world, except Central and Eastern Europe and Western Asia. It is known as the tree lobelia, and thrives only on the slopes of the high mountains of tropical Africa. It is a cousin of the "Indian tobacco" of North America, whose chief constituent, lobeline, closely resembles nicotine.

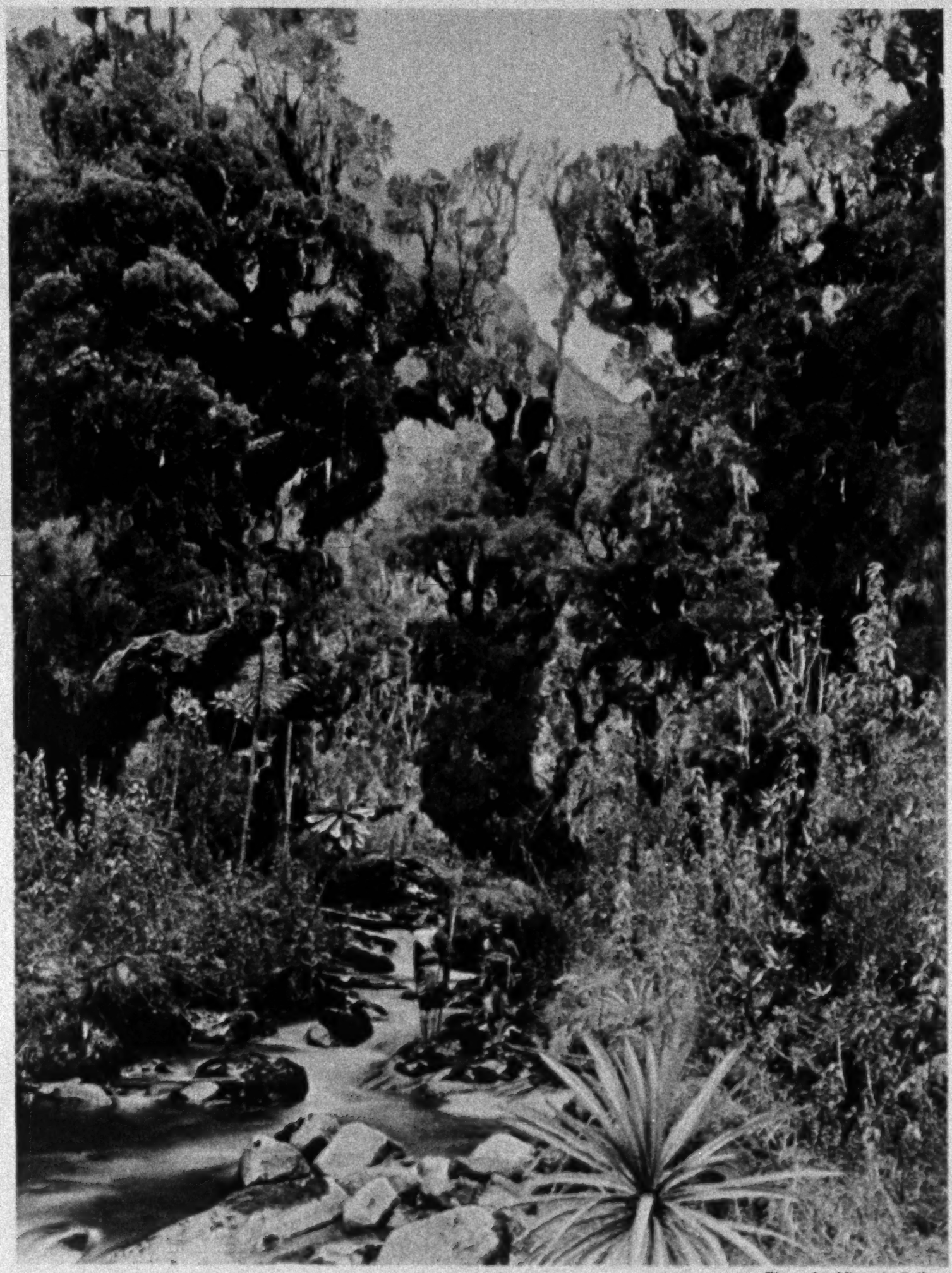


Photo by Vittorio Sella

THE RUWENZORI MOUNTAINS, AFRICA

The headwaters of this little river form a mere Alpine stream buried in fantastic vegetation. Its yellow-brown waters are without fish or any other form of life. The surrounding ground is covered with heath forest and an underwood of tall ferns, creeping plants, orchids, and thorny brambles laden with blossoms and unripe blackberries. In their shade grow violets, ranunculus, geraniums and many other beautiful flowers. The men in this picture were members of the mountain climbing party of the Duke of the Abruzzi.

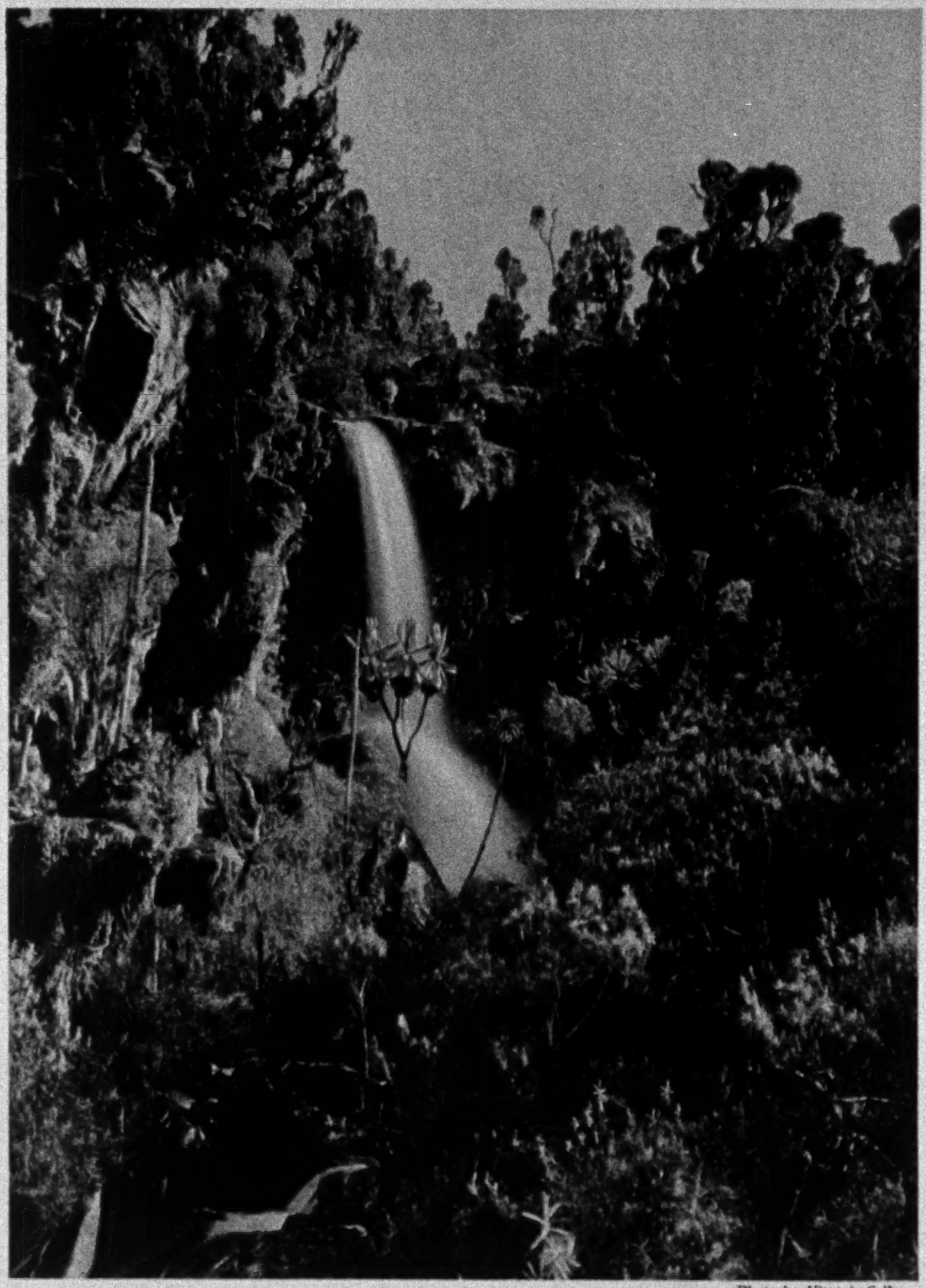


Photo by Vittorio Seila

WATERFALL AT BUAMBA, MOBUKU RIVER, AFRICA

Framed in foliage and flowers, this graceful waterfall leaps from one plateau to another, in a region where many traces have been left of the former passage of glaciers, the rocks being worn smooth and streaked. There are also many moraine piles, boulders and other debris, now hidden in the dense growth of a hundred hues which fringe the base of the Kiyanja Peaks.

Photo by Vittorio Sella

THE WONDERFUL VEGETATION OF THE RUWENZORI MOUNTAINS, AFRICA

Situated almost under the equator, on the borderland between the Belgian Congo and Uganda, the Ruwenzori Mountains are famous for their wonderful vegetation. Many richly aromatic plants keep the mountain climber company until an altitude of 11,500 feet is reached. As they drop by the wayside, the helicrysum or "everlasting flower," takes up the task of cheering his pathway, and goes with him to the very foot of the glaciers themselves.

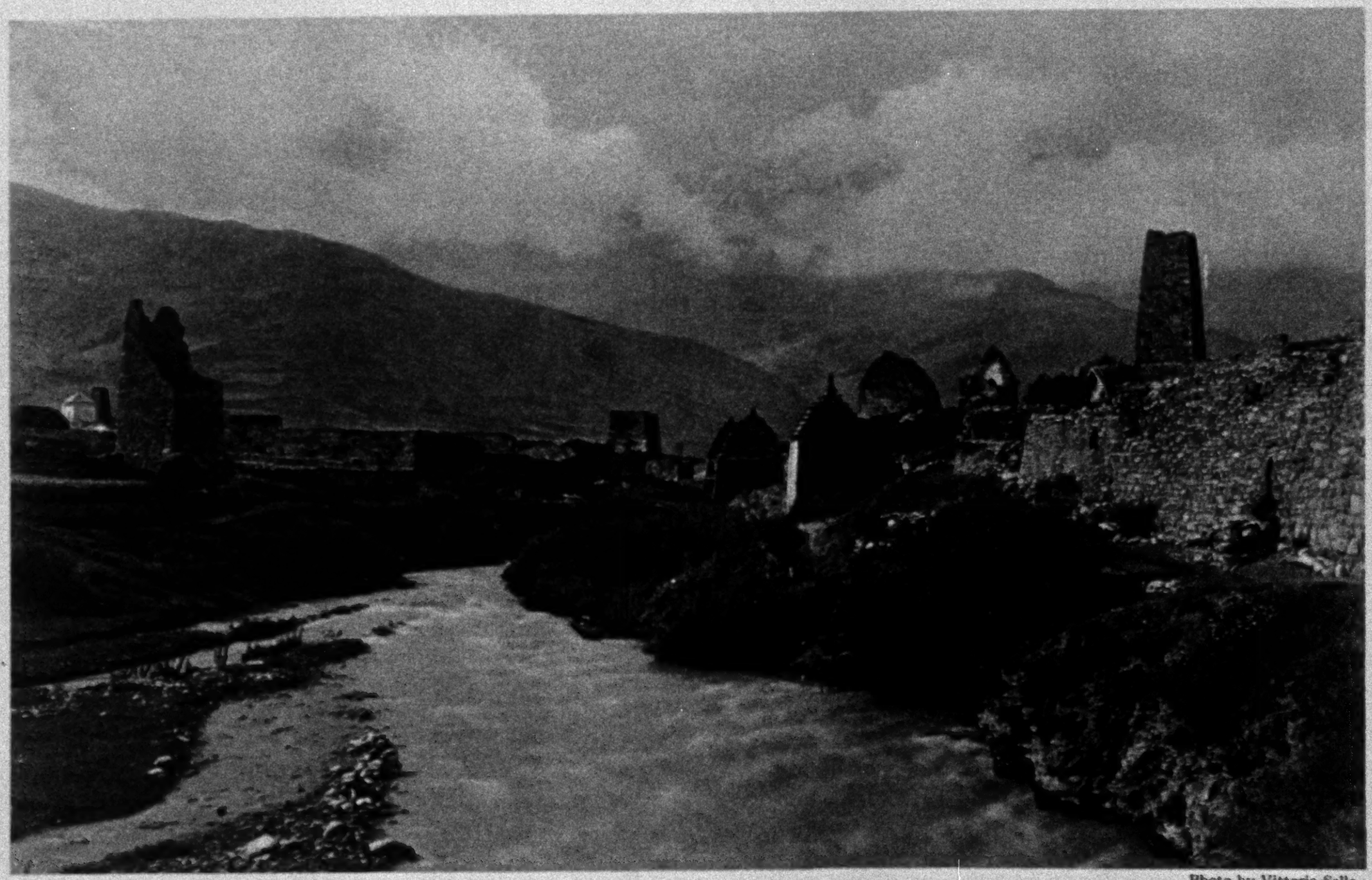


Photo by Vittorio Sella

THE VILLAGE OF DALAKAFF, IN THE VALLEY OF THE LIAGDON, CENTRAL CAUCASUS, RUSSIA

An old legend says the Babel of the Caucasus cannot be reduced to writing. It reads: "Give up your task. Can you put into human writing the rolling of the thunder along the peaks, the crash of the falling avalanche, the deep roar of the mountain torrent, the blast of the waterfall? Can you represent the sound of the stones as they clatter down the gorges, of the branches of the forest as they moan in the tempest, the screams and songs of the birds as they call to one another from height to height? How, then, can you hope to imprison in letters the free speech of the tribes of the Caucasus?"

THE BIG TREES OF THE MARIPOSA GROVE, CALIFORNIA

The sequoias of California, the tree monarchs of the world, are one of the few surviving links which establish the kinship of the cypress and the fir. Once they were widely diffused over the earth. During the Ice Age they seem to have been exterminated except in the California mountains, where they never come closer to sea level than 5,000 feet and are not able to grow above 8,400 feet. They sometimes attain a height of 320 feet and trunk diameter of 35 feet.

THESE RECORD STONES WERE OF MANY SIZES AND COLORS

"'Their bodies were embalmed with their royal insignia round about and the treasure and jewels which each one sent, if they could. Above each one extended a hole or little niche, where a small figure of clay, stone, or metal was represented, and inside were the small stones, of various shapes and colors, which denoted his age, the years, and the month of his reign.'

"Velasco gives one other reference to the use of the little stones in place of *quipos*; but, aside from this single authority, we find no other statements regarding this interesting method used by the Caras, after, according to their own traditions, they had left the low coastlands and migrated, by way of the Esmeraldas Valley, to the highlands in the vicinity of Quito. The little stones of distinct sizes, colors, and angular shapes, used for the purpose of keeping historical and other records, are thus found on the coast in the examples from La Plata, Cerro, Jaboncillo, and La Tolita, not far distant from the southern frontier of Colombia, and each varies with the locality." (Saville: "The Antiquities of Manabi, Ecuador," pages 172-173.)

At Machu Picchu, hundreds of miles south of Ecuador, we have quantities of similar stones, including many regular and irregular shapes (see page 204). The irregular ones can hardly be classified. The regular forms are disks, oblongs, and triangles.

Of the *156 stone disks* found at Machu Picchu only three were found in the caves containing skeletal material opened by Dr. Eaton. In fact, the great majority of them appear to have belonged to an earlier culture than that represented by the times of the skeletal material.

The diameter of the largest stone disk found in Machu Picchu is 23.5 cm. (or about 9 inches), and of the next largest, which is rather oval in shape, 23 cm. x 21 cm. The largest one was found in the center of the Upper City, the other on one of the terraces. Both are rough-hewn, partially ground and polished.

Of the others we find only one of the disks to be less than 1 cm. (an inch being 2.54 centimeters); the others range as follows:

		cm.		cm.
6	between	1.0	and	1.5
18	"	1.5	"	2.0
21	"	2.0	"	2.5
33	"	2.5	"	3.0
10	"	3.0	"	3.5
15	"	3.5	"	4.0
6	"	4.0	"	4.5
4	"	4.5	"	5.0
4	"	5.0	"	5.5
2	"	5.5	"	6.0
2	"	6.0	"	6.5
4	"	6.5	"	7.0
6	"	7.0	"	7.5
2	"	7.5	"	8.0
3	"	8.0	"	8.5
1	"	8.5	"	9.0
2	"	9.0	"	9.5
5	"	9.5	"	10.0
1	"	10.0	"	10.5
1	"	10.5	"	11.0
1	"	11.0	"	11.5
3	"	11.5	"	12.0
1	"	12.0	"	12.5
2	"	12.5	"	13.0
1	"	13.0	"	13.5

1 only over 13.5

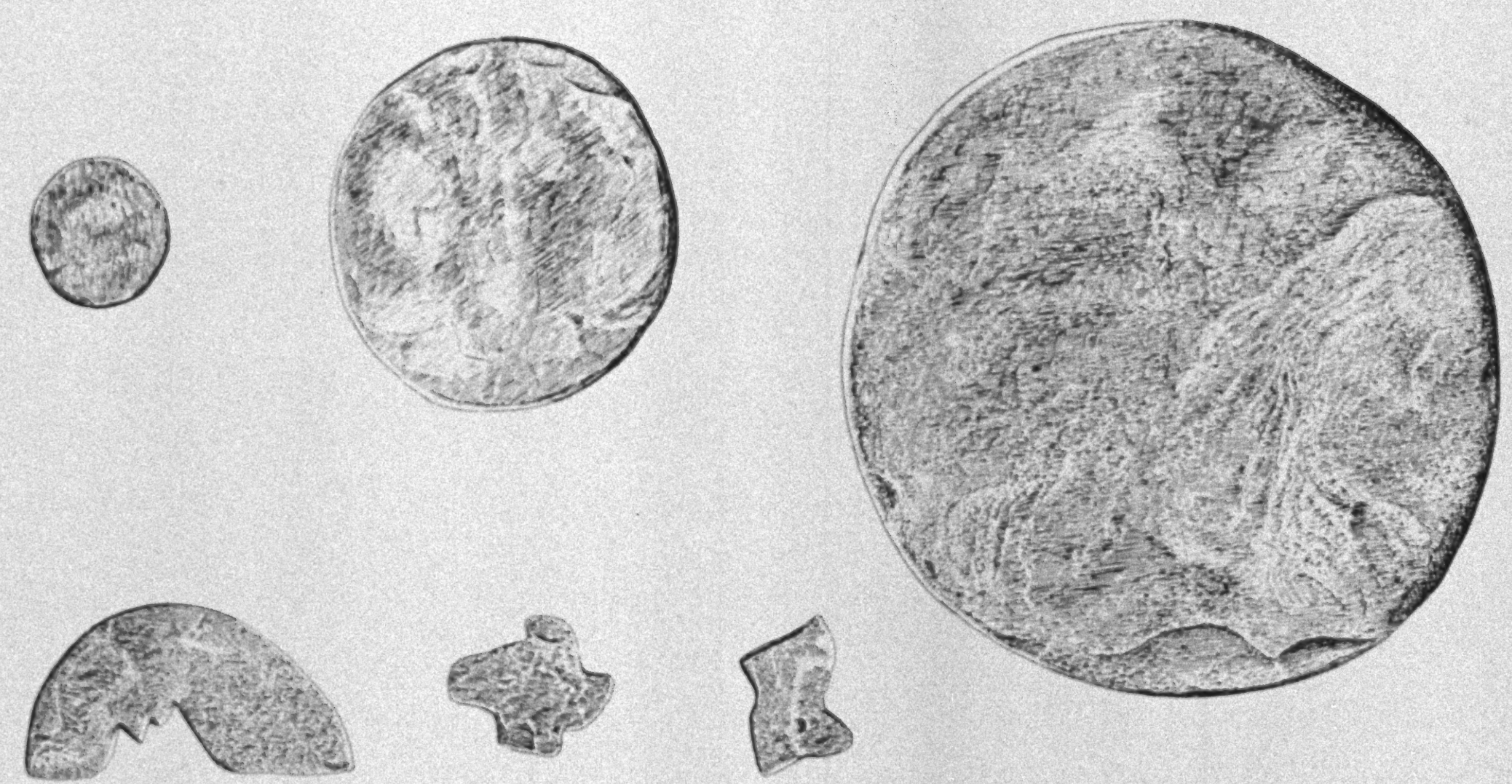
THE MYSTERY OF THESE STONES

It will be noticed that every half centimeter is represented by one or more disks from the largest to the smallest. There are many more small ones than large ones, one-half of the disks being 3 cm. or less in diameter. However, it seems impossible to draw any hard and fast dividing line between the sizes.

I have thought that some of the larger, rougher disks might have been used as pot covers. If, however, all were used as counters, the relative infrequency of large numbers (supposing that the large counter signified a large number) would account for the relative scarcity of the larger disks.

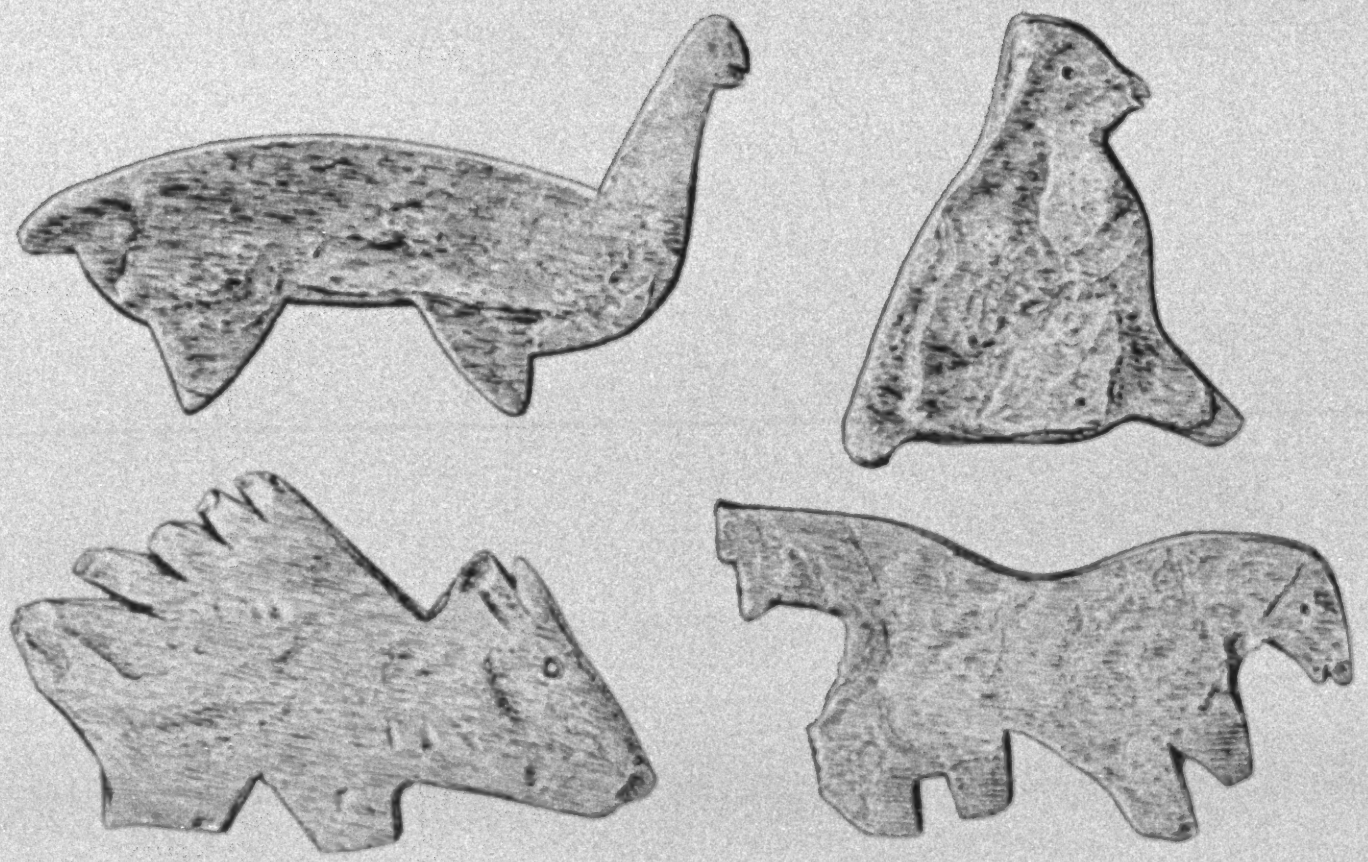
Most of the large disks are roughly made, but a few are nicely rounded, and are ground and polished to a fairly consistent thickness. The largest of all are rough-hewn, but partially ground and polished. Only one is clearly purposely incised—that measuring over 13.5 cm. This has a single cross on one side in the center of the disk, the two lines being respectively 4.5 cm. and 5 cm. in length. One disk was found notched with four notches, and four disks were perforated.

A careful examination of the smaller



STONE DISKS RESEMBLING POKER CHIPS AND OTHER CURIOUS STONES, ALL PROBABLY RECORD STONES. 1¼ TIMES NATURAL SIZE

One hundred and fifty-eight of these disks were found in excavating the older part of the city. They were probably used by the earliest inhabitants of Machu Picchu as record stones; but later, in the time of the Incas, were superseded by the knotted string, which was a far more flexible, easily preserved, and carried record (see text, pages 175, 186, and 203).



LITTLE STONE FIGURES OF ANIMALS CARVED OUT OF GREEN MICACEOUS SCHIST

All found in one grave and representing jungle animals—that is, the peccary, the ant-eater, otter, and the parrot—evidently intended to be the record of a visit to the dense jungles of the lower valley by some artistic stone artificer. 1½ times natural size.

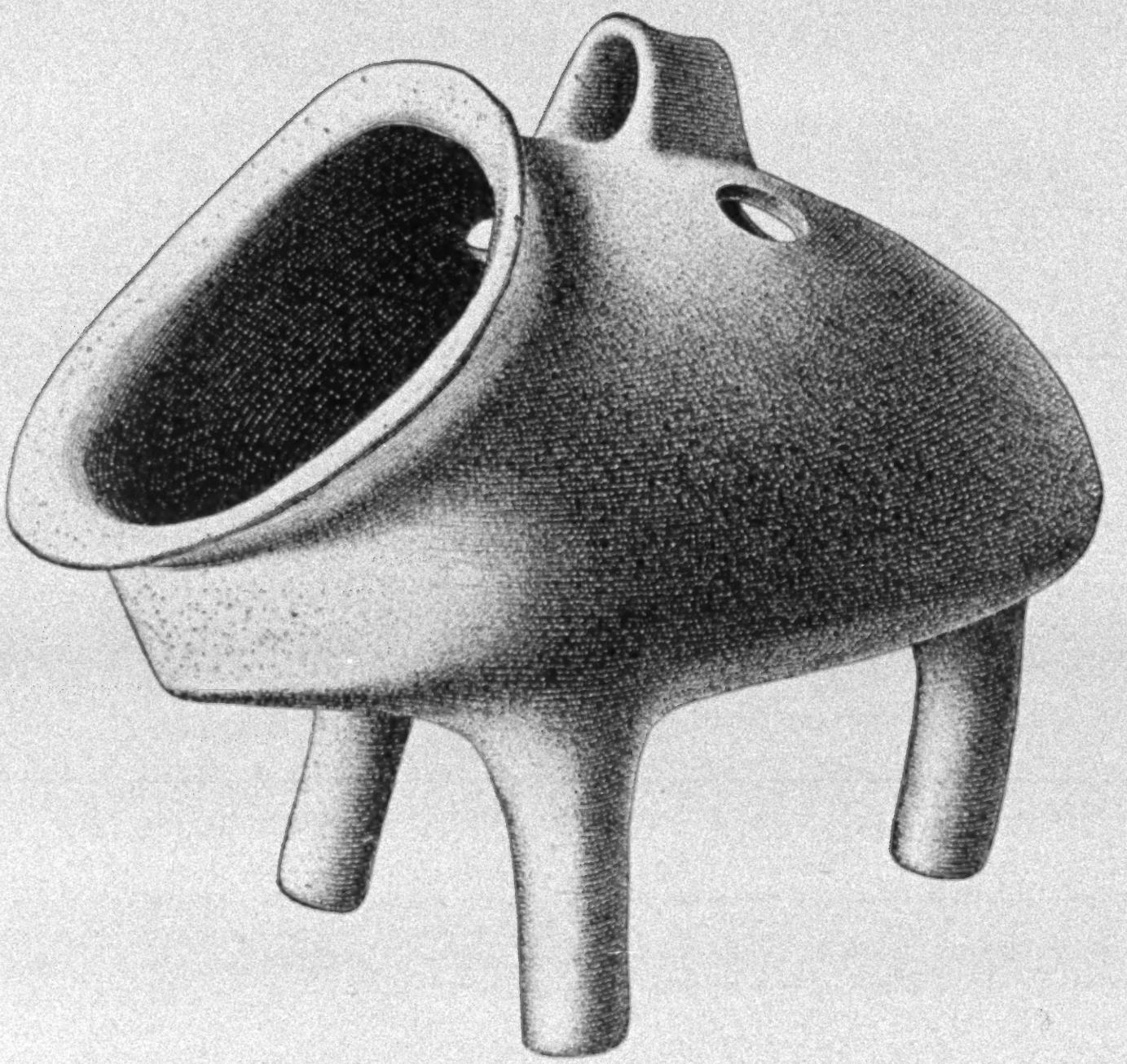
disks or counters shows that practically all were ground and polished, some more, some less. A large number of them are nicely rounded. Nearly all show scratches made in the grinding and polishing, and a few are ground so thin as to be translucent. The scratches are in a few cases puzzling, but we have not been able to come to the conclusion that the scratches were intentional or graphic.

On perhaps a dozen of the disks the scratches are suspicious; but in none of these cases can one say that they are not accidental. Certainly there is no regular rule about the scratches, and their suspicious character consists in occasional markings that resemble tallying. The stone of which these disks are composed, green chloritic schist, is soft, easily scratched, and quite suitable for being marked with tallys if it were so desired. If that had taken place, however, I believe that we should be in no doubt about the marking. There are tally marks on the baked-clay dice or cubes (see page 176).

An exceedingly well-made group of these smaller disks, 16 in all, besides a discoidal stone pendant of similar size, was found in one hole near the Snake Rock. All of them are carefully ground and polished, and all bear, in addition to the marks of grinding and polishing, suspicious scratches. Fourteen of them are 3 cm. in diameter, one is 4.5 cm., and one a trifle over 6 cm.

In two or three cases flat discoidal pebbles of similar material were found in connection with the ground and polished disks

Forty-two *oblong* problematical or "record" stones were found, all of them of the same material—green chloritic schist. Two or three are thicker and rougher than the others, but most of them are about 0.3 cm. in thickness. The longest is 5.8 cm. in length and about 2 cm. in width. The widest is 3.2 cm. in length and about 2.5 in width. The smallest is 1.4 cm. in length and about 0.3 cm. in width. Nearly all bear marks of having been ground and polished, but none appears to have been engraved, although a number have irregular scratches of a suspicious character, which might, however, have been made accidentally in the course of manufacture. Nearly all thirty-one came from



THE THREE-LEGGED BRAZIER, A PARTICULARLY IMPORTANT STYLE OF POT FOUND AT MACHU PICCHU. 2/3 NATURAL SIZE

the Snake Rock region and the Upper City.

Nineteen *triangular*, or roughly triangular, unpierced, problematical stones were found, generally in places where the other types of record stones were discovered. None was found in any of the burial caves.

RECORDS ANTEDATING THE INCAS

These "record stones" probably belong to an earlier culture than that of the Inca. In the first place, they have been hitherto almost unknown in collections of Peruvian antiquities, although this may be due to their apparent unimportance. In the second place, they do not occur at Machu Picchu in connection with the burial caves containing Inca or Cuzco style pottery, and not more than half a dozen appear to have found their way into any of the caves containing skeletal material. In the third place, they were not found in excavations in the houses of undoubtedly Inca construction; and, finally, they do occur in greatest profusion in the excavations in the vicinity of the Snake Rock and the Sacred Plaza. The Snake Rock region is very likely an ancient pre-Inca cemetery.

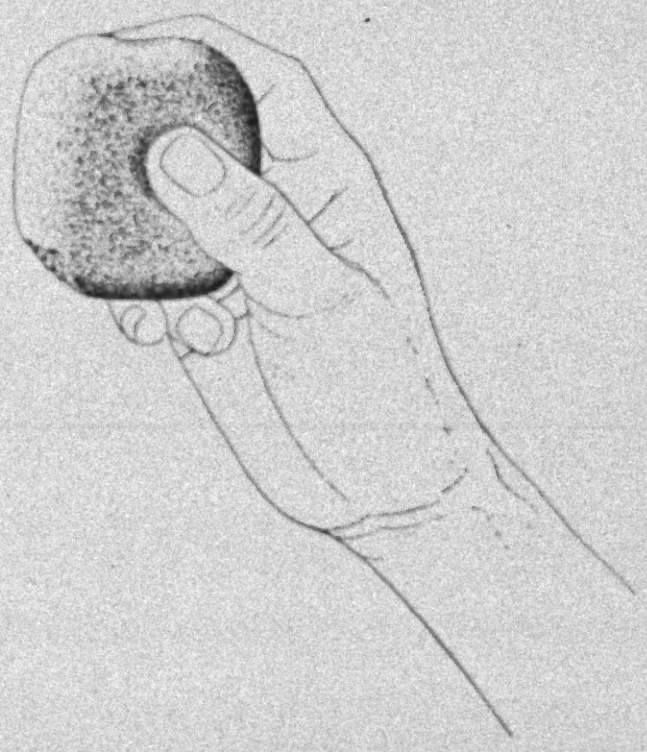
Five obsidian flake knives were found, varying in size. All were found within a fairly short radius of the Snake Rock, two being near the Sacred Plaza, one at the head of the Main Stairway, and one at the entrance of the Upper City. None was found in any of the burial caves, in

the excavations in the Eastern City, nor in the Lower City.

In an excavation near the Main City Gate of the Upper City 29 obsidian pebbles, slightly larger than ordinary marbles, were found. These chunks vary in size from 2.2 cm. x 1.7 cm. x 1.5 cm. to 0.9 cm. x 1 cm. x 0.9 cm., and in weight from 6 G. to 1 G. One more was found in an excavation a few feet away, but not one was found anywhere else. Most of them might be described as sub-angular in character and somewhat faceted in shape.

Professor Pirsson, of the Sheffield Scientific School, who examined them, tells me that similar pebbles are found scattered all over the world. Specimens have been picked up in Austria-Hungary, Moravia, Honduras, and Arizona. The finding of these rounded chunks of volcanic glass where there is no volcanic action has led to the suggestion that they might be extra-terrestrial, possibly a "meteoric shower." From their location, near the city gate at Machu Picchu, they were probably used as record stones.

Finally, we must continue the search for "record stones" in Inca ruins. They may not be found. On the other hand, they may have been overlooked by former collectors. They certainly would have been overlooked by treasure hunters.



TYPICAL HAMMER-STONE, SHOWING THE WAY IN WHICH THE BUILDERS OF MACHU PICCHU FINISHED THEIR WONDERFUL BUILDING STONE

Hundreds of hammer-stones were found, indicating the great importance and frequent use of this ancient implement, which enabled the old stone-masons to accomplish almost impossible feats. ½ natural size.

MUCH IMPORTANT MAPPING WAS DONE IN 1914

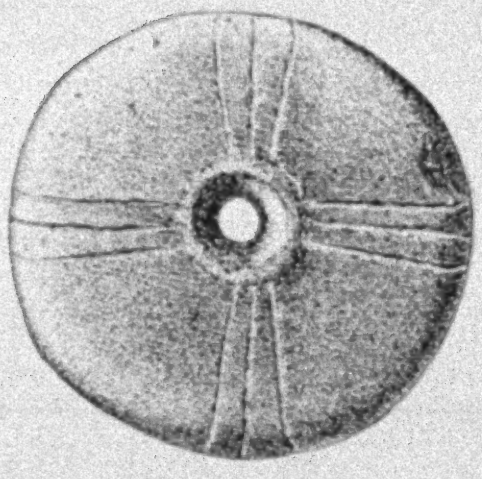
One of the greatest handicaps in the way of scientific work in all of this region is the lack of accurate and adequate maps.*

Accordingly it was felt that the best way to prepare for the scientific work of the Expedition of 1915 would be to send out two or three topographic parties in 1914, who could utilize the information gathered in 1911 and 1912 to prepare better maps than anything we have had.

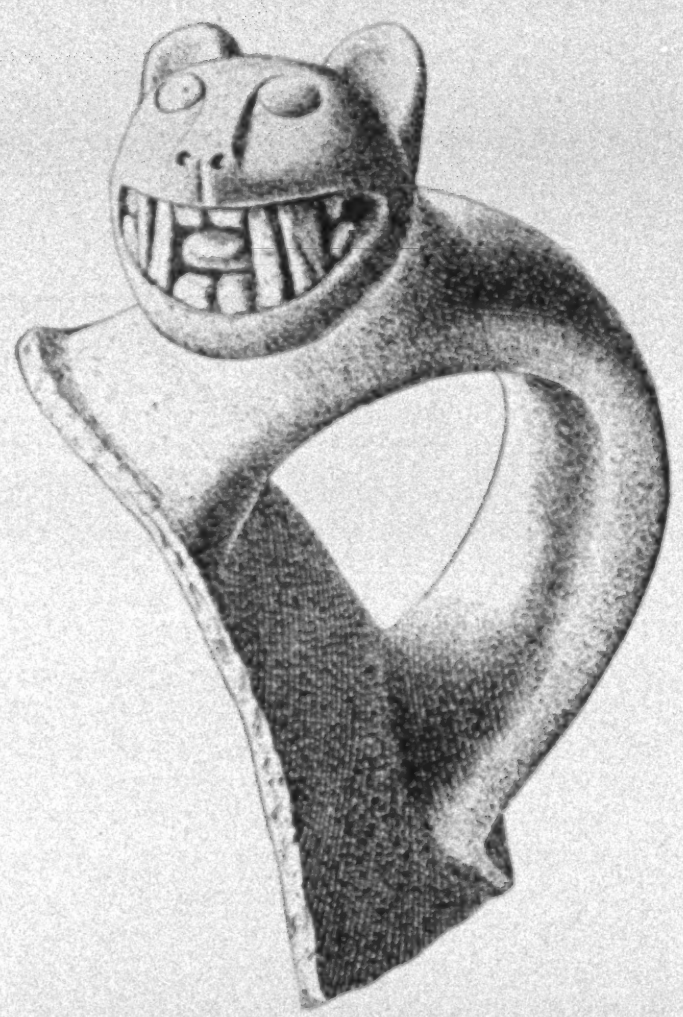
With the consent and approval of the Peruvian government, we began our field work in 1914 by making a geographical reconnaissance of that portion of southern Peru which includes the Cordillera Vilcabamba and other portions of the watershed of the Apurimac and Urubamba rivers within a radius of 100 miles of Cuzco. Much of the country is on the edge of the great Andean plateau.

The Cordillera Vilcabamba is a chain of magnificent mountains, rising from 15,000 to 20,540 feet above sea-level, and reaching their highest point at the beautiful peak known as Salcantay. The tops of many peaks are 12,000 feet above the floor of the canyons at their base. Since their bases are situated between latitudes 12 and 14 S., they are clothed with tropical jungles, while the peaks, on account of their great height, are mantled with snow and glaciers, and form one of the largest undescribed glaciated regions in the world. The first description of a scramble through the heart of this great glaciated country was given by the writer in the April, 1913, number of the NATIONAL GEOGRAPHIC MAGAZINE.

*One of the most interesting results of the topographical work of the 1912 Expedition was the discovery that the course of the great river Apurimac is quite incorrectly laid down on the Peruvian maps. At Pasaje it is 20 miles farther away from the Urubamba than the government maps show it to be. As a result interesting possibilities for discovery and exploration have been opened up in a region some 600 square miles in extent, an area which did not heretofore exist on any map.



CLAY SPINDLE WHORLS USED BY THE WOMEN OF MACHU PICCHU IN SPINNING WOOL



THE HANDLE OF A JUG DECORATED WITH A JAGUAR'S HEAD

This is partially hollow, so that a string may be passed in the teeth in such a manner as to support the jug.

Thanks to the courtesy of the government of Peru, arrangements were made with the government's wireless station in Lima to have time-signals sent out, so that more exact data than any hitherto available could be obtained in determining the longitude of the area to be mapped. For this purpose two sets of wireless receiving apparatus were provided, one of which was installed at the Harvard Observatory in Arequipa, where, through the courtesy of Prof. E. C. Pickering, the time-signals were also received and recorded.

In order to get the receiving wire high enough in the air to overcome the distance over which the wireless time-signals must travel, it was proposed to use a number of box-kites arranged tandem, but experience proved that it was not necessary to do more than raise the receiving wire a few feet above the ground.

Our Chief Topographer, Mr. Bumstead, was with the topographical branch of the United States Geological Survey for a number of years, and had the advantage of our 1912 field season in one of the most difficult parts of Peru. As he was familiar with wireless telegraphy, the determination of the longitudes of the region mapped has been done with great accuracy.

With Mt. Salcantay as a center, we have now succeeded in mapping the surrounding territory as far as it is practicable to do so. The character of the map and its extent have depended largely on the weather and, to a certain extent, on the ability of the topographers to do difficult mountain climbing.

RACING WITH THE CLOUDS

In his report on the results of this season's work Mr. Bumstead says that 52 per cent of daylight, during the "dry season," weather conditions were so bad as to make topographic work impossible.

He continues:

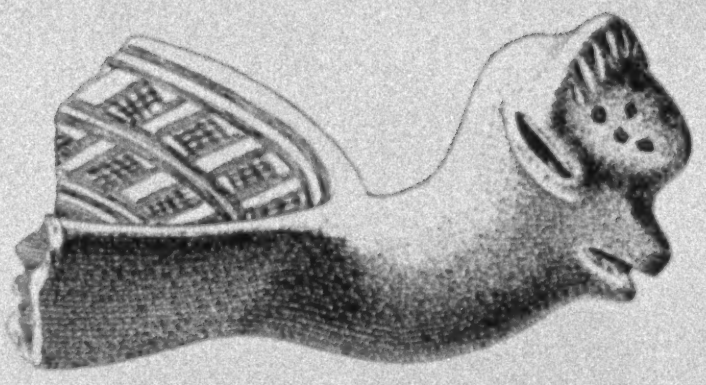
"While in the country around Salcantay, and particularly on the westerly side, cloudiness and rain were almost continuous throughout the season, the fog extending down nearly to the bottoms of the valleys. It was in this region that my most important work was centered, and I spent much time there making a desperate effort to get work done. Many peaks were climbed in the dark in order that I might be ready to work at sunrise, for I found that that was the time when I was most likely to be able to see. The clouds would frequently clear away in the night and begin to gather again at

sunrise or very soon after. On one important peak, at an elevation of 15,157 feet, that was too difficult to climb in the dark, I remained out over night; but the discomfort and risk was so great that I decided not to do it again.

"My usual program of work in this region was to get started from camp early enough to go as far as was safe in the dark, and the rest of the way to my point in the morning twilight, which in these low latitudes is very short. Then there would be a desperate uphill race between the clouds and me, and the clouds usually won the race! I want to say that this racing uphill at altitudes around 14,000 to 16,000 feet, frequently carrying instruments, with the almost certain knowledge that the clouds would get there first, and the knowledge that if they did another valuable day would be lost, is an experience that, if oft repeated, will have a decidedly dampening effect on one's ardor for topographic surveying. When I was so fortunate as to win the race and see that I would have a few minutes, or perhaps an hour, to work, I would get my location and elevation by regular plane-table methods and get lines and vertical angles to the most important points.

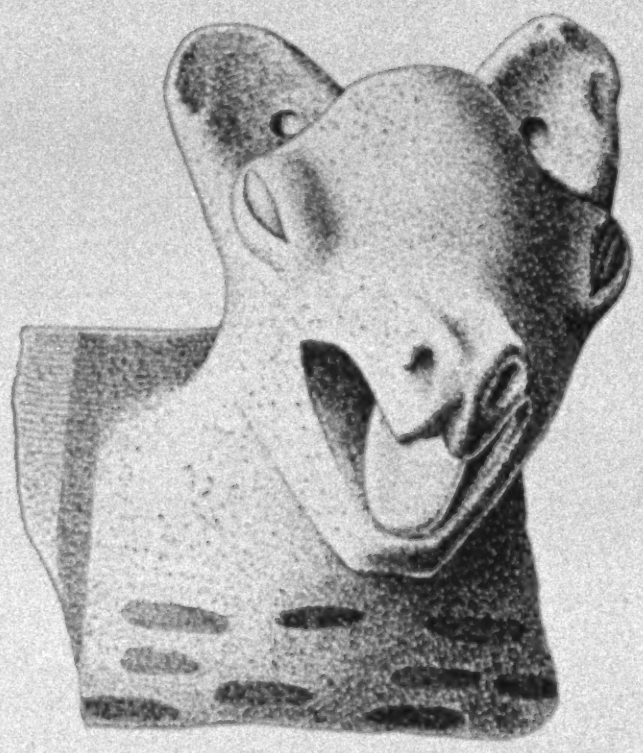
"Then I would take a series of photographs around the horizon, with the camera set on the leveled plane-table. In my photographic record I noted the direction of camera by measuring angle, with a protractor between it and a true meridian drawn on the plane-table sheet. From these photographs I hope to be able to fill in much of the detail that it was impossible to sketch in the limited time before everything was obscured by fog. When weather permitted, I went ahead with detail sketching by ordinary methods."

A second topographic party, under the leadership of Mr. E. L. Anderson, covered during the field season of 1914 a large unexplored area between Mt. Salcantay and the Huarocondo Valley. In this region was found the interesting fortress of Huata and a considerable number of other ruins that have not hitherto been reported, and which ought to be carefully studied some time in the future. Mr. Anderson's party covered altogether about 400 square miles, of which 120 were southwest of Cuzco, near Paccaritampu, which has long been [erroneously?] supposed to be the site of Tamputocco, the windowed tavern from which the Incas came to Cuzco.



THE DESIGN ON ANOTHER HANDLE OF THESE LADLES

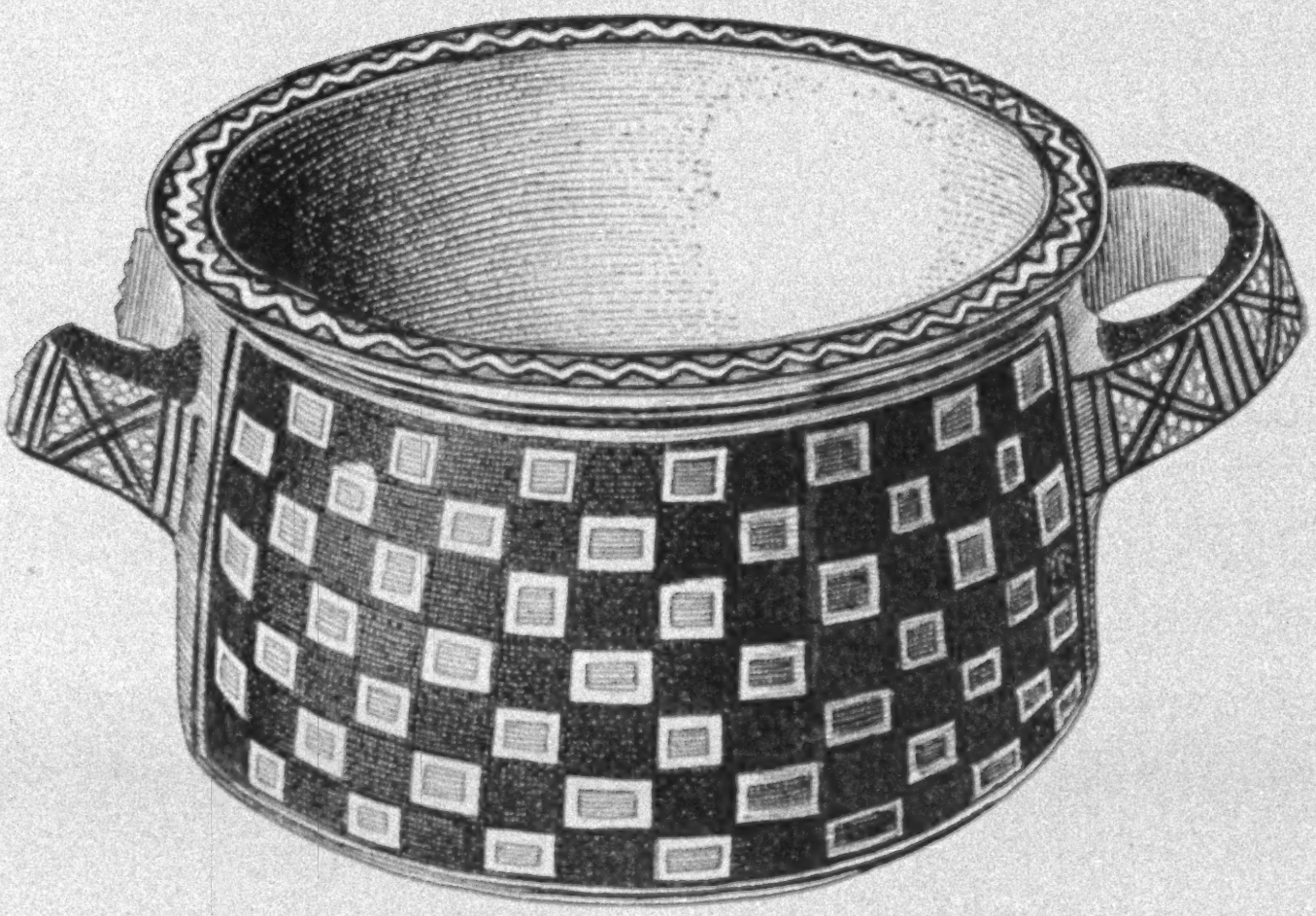
Which intimates that the ancient Incas had a sense of humor and a lively imagination in art.



THE MOST CHARMING AND LIFELIKE REPRESENTATION OF AN ANIMAL'S HEAD FOUND AT MACHU PICCHU

It appears to be one handle of a deep two-handled dish and seems to represent a baby llama. The modeling and the spirit in which it is worked out are most delightful.

During the season of 1914 several interesting archeological finds were made, including some small wooden and bronze artifacts at the edge of a glacier, 16,000 feet above sea-level, which would seem to indicate that some Inca had been buried or lost on the ice.



TWO-HANDLED DISH USED BY THE INCAS FOR SERVING THEIR FOOD

They were painted in three colors, with geometric patterns, the same on each side. The dish was evidently intended to be set down between two persons, since it is equally attractive on either side. ¾ natural size.

THE 1915 EXPEDITION

It would be foolish to attempt to predict how much will be accomplished by the expedition in 1915; but as a portion of the area to be covered has only just been mapped, and several hundred square miles lie in virtually unexplored territory, it is hoped that the results will prove geographically interesting and scientifically valuable.

The personnel of the Expedition is as follows:* *Director*, Hiram Bingham.

Geologist, Herbert E. Gregory, Ph. D., Silliman Professor of Geology in Yale University, Geologist of the Society's 1912 Expedition.

Naturalist, Edmund Heller, Naturalist of the Smithsonian African Expedition, under the leadership of Col. Theodore Roosevelt.

Botanist, O. F. Cook, Ph. D., of the U. S. Department of Agriculture.

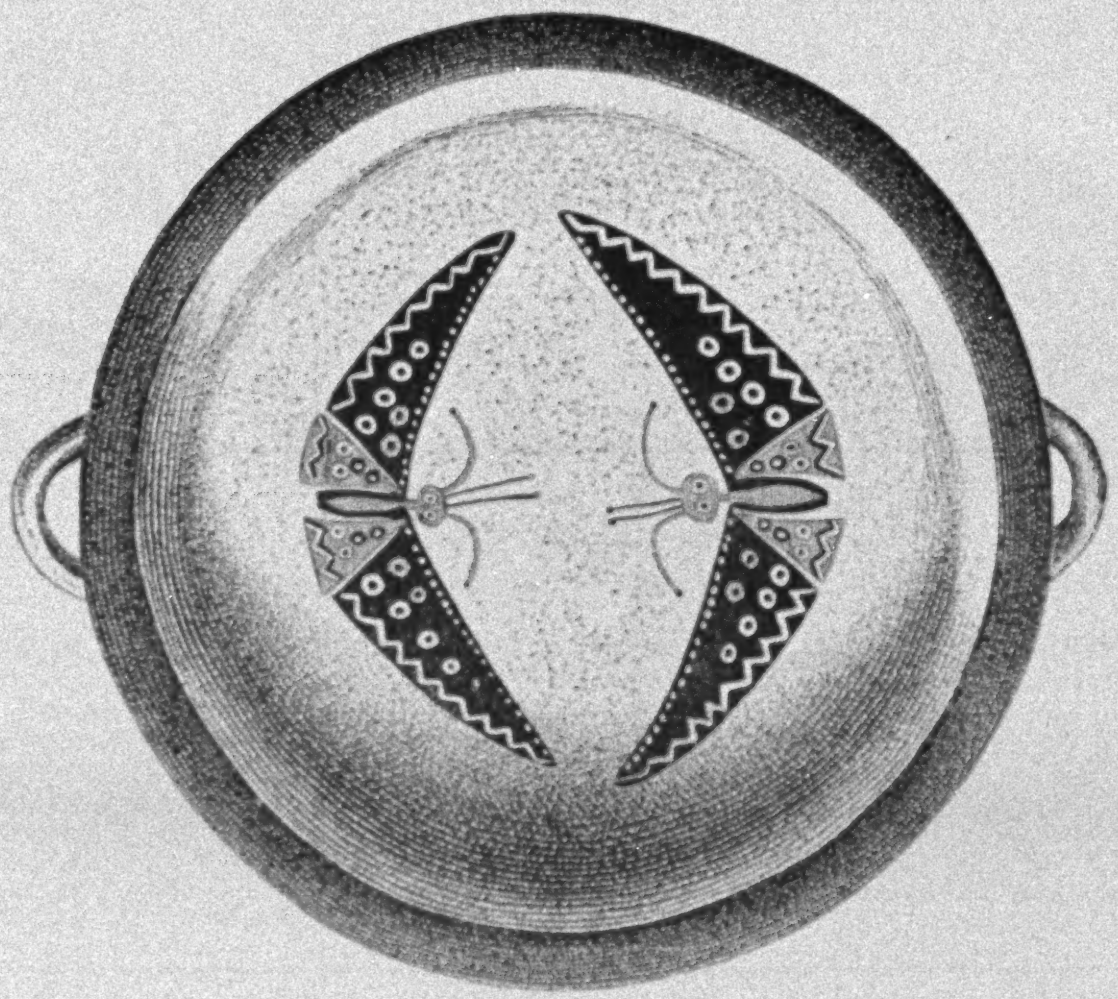
*All the members of the expedition (excepting Professor Gregory) sailed from New York March 3, 1915, on S. S. *Zacapa* bound for Peru.

Surgeon and Physical Anthropologist, D. E. Ford, M. D.; *Topographical Engineer*, Albert H. Bumstead, of the 1912-1914 Expeditions; *Topographer*, Edwin L. Anderson; *Chief Engineer*, Ellwood C. Erdis, of the 1912-1914 Expeditions; *Engineer*, J. J. Hasbrouck, Ph. B.; *Chief Assistant and Interpreter*, Osgood Hardy, M. A., of the 1912-1914 Expeditions; *Assistant Topographer*, Clarence F. Maynard, C. E.; *Assistant Botanist*, G. B. Gilbert, of the U. S. Department of Agriculture.

THE MOST ATTRACTIVE FIELD FOR EXPLORATION IN THE WORLD

There is no part of the world which offers to the scientific explorer a more attractive field than the highlands of Peru and Bolivia.

In the first place, this region contains the vestiges of the most ancient and most advanced culture in South America. These remains consist in part of the ruins of roads and aqueducts; walls and terraces, fortresses, towns and cities. Besides the works of the ancient engineers



A SMALL TWO-HANDLED SAUCER WITH A MOST CHARMING DESIGN IN THREE COLORS REPRESENTING SOMEWHAT DIAGRAMMATICALLY A PAIR OF BUTTERFLIES

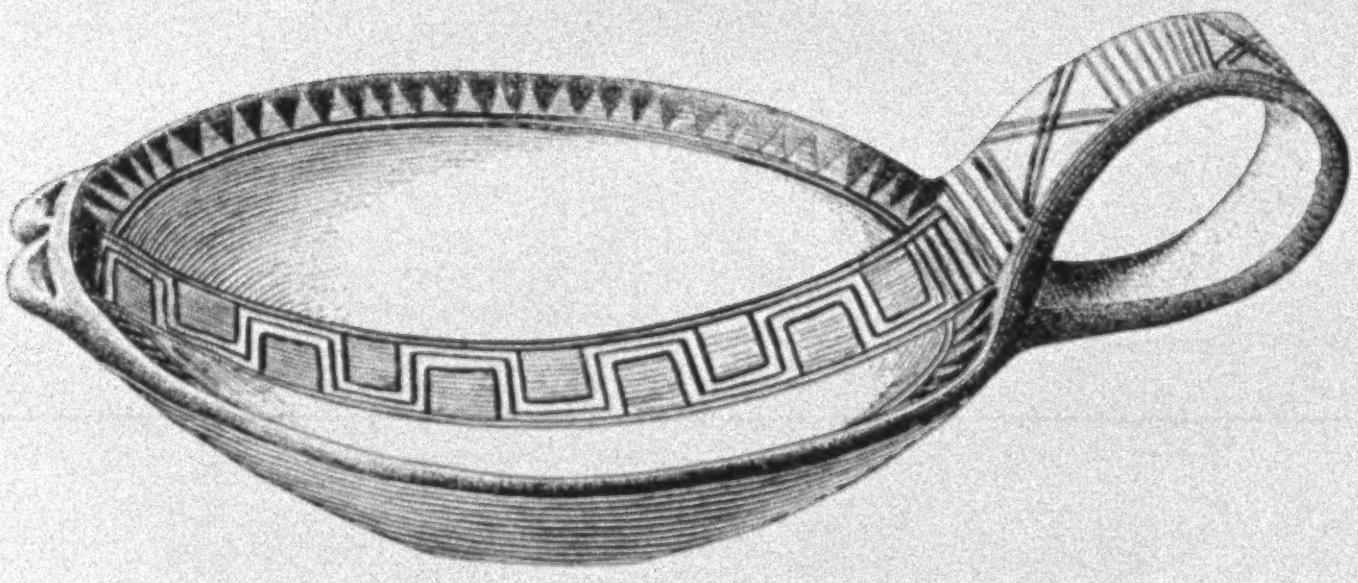
Two of these dishes were found in one cave at Machu Picchu along with a skeleton of a tall woman, possibly the high priestess. The other articles in the cave were also of superior quality. This pair of saucers is one of the best examples of the highest stage of the development of Inca pattern. ¾ natural size.

and architects, there are the fragmentary remains of the ancient metallurgists, potters, and weavers. Here and there in old burial caves may be found specimens of bronze and silver ornaments, tools, and utensils. Originally there was considerable gold to be found; but four centuries of treasure-seekers have left so little in the way of precious metals for the modern explorer that he must have other objects in view or he will be sadly disappointed.

The larger part of the population of this lofty American Tibet today is composed of non-Spanish-speaking Indians. Their commonest language is Kechua or Quichua, which was taught to their ancestors and probably forced upon them by the Incas, who flourished between 1100 A. D. and 1572 A. D. In many villages there has been so slight an element of European influence that manners and customs of very ancient origin may still be observed and studied.

Our knowledge of the distribution of the ancient peoples who preceded the Incas and of the gradual formation of the Inca Empire is based largely on the writings of the Spanish conquerors and their friends. These writings are full of exaggerations and misstatements, so that our information in regard to the Incas and the other ancient tribes of the Andes is very uncertain.

The historical geography of the Andes of Peru and Bolivia offers a series of problems of intense interest. These include the origin of the ancient cities, such as Tiahuanaco, Cuzco, and Machu Picchu; the relation of the different types of architecture, including the monolithic, the adobe, and the rubble; the question of the migration of races, the spread of the ancient civilization, and the sequence of cultures, besides a thousand and one queries as to the manners and customs, government, religion, and philosophy of those illiterate but very skillful engineers



A LADLE OR DISH WITH ONE HANDLE, USED BY THE INCAS AS A SOUP PLATE

It is painted in three colors, inside the dish and on the handle, in a very attractive pattern, reminding one of the decoration used on Greek pottery. The two incised nubbins opposite the handle are evidently an echo of the time when the dishes had two handles. One handle got broken off, and it was discovered that the dish was even more convenient than when it had two handles. In hundreds of examples of this type of dish in the Machu Picchu collections and in the great museums containing collections of Peruvian pottery we have found a very few cases in which these nubbins were not incised, but cases in which the incision goes all the way through and becomes a perforation. The dish may very conveniently be held in the hand, the thumbs going through the loop of the handle. ½ natural size.

and soldiers, the Incas, and their predecessors, the "Megalithic Folk."

When one considers the many attractive features of this ancient civilization—the picturesque location of the towns, the beautiful stonework, the symmetry of the buildings, the difficult engineering feats that are frequently in evidence, the attractive designs on pottery and textiles, the skillful metallurgy, and above all the stories of remarkable governmental organization made familiar by the fascinating volumes of Prescott—our zest for exploration and discovery in this region may readily be understood.

UNDESCRIBED ANIMALS

There is the appeal of geology and physiography. It is believed that southern Peru contains the key to the structural growth, erosion epochs, and stratigraphic history of the Andes, and to climatic fluctuations of great range. The reported presence of irrigation ditches at high elevations suggests interesting studies relating to the shifting of population due to climatic and other changes.

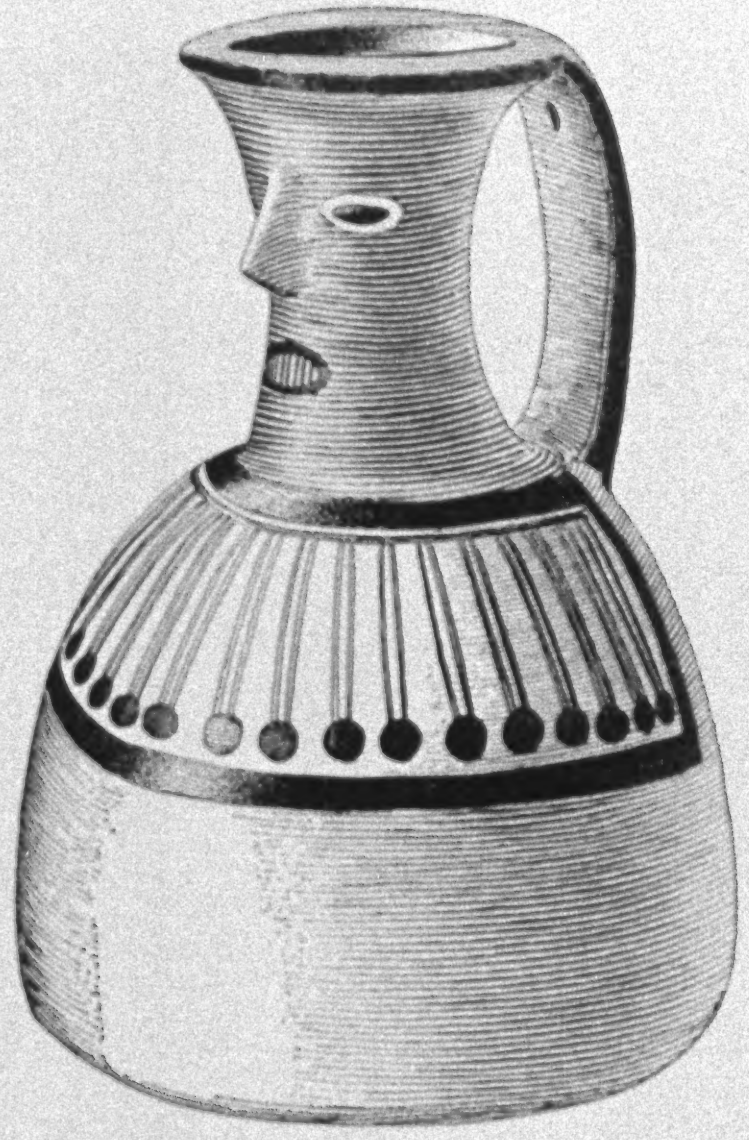
Furthermore, this area is so little known to geologists and paleontologists that the chance of making interesting and important discoveries is considerable. Many unexplored and even unlocated extinct lakes of Pliocene and Pleistocene times probably exist on this plateau, which, like the Ayusbamba, visited in 1912 (see the NATIONAL GEOGRAPHIC MAGAZINE, April, 1913, page 501), may be expected to yield vertebrate fossils.

From the point of view of zoology, remarkably little is known of the animal life of this region, considering the length of time that it has been opened. In the great museum collections there are very few specimens of the fauna of the Andes of Peru and Bolivia. It is believed that there are many new species of mammals yet to be described. The Andean bear, the so-called "spectacled" bear, which is so very shy, and of which no specimens have been brought home from southern Peru, is fairly common in this region.

On the botanical side the region is particularly interesting as being the original home, it is believed, of some varieties of our more common articles of food, such as the potato and Indian corn. Furthermore, we find here several edible roots and vegetables that are unknown in the United States, and which may be worth transplanting.

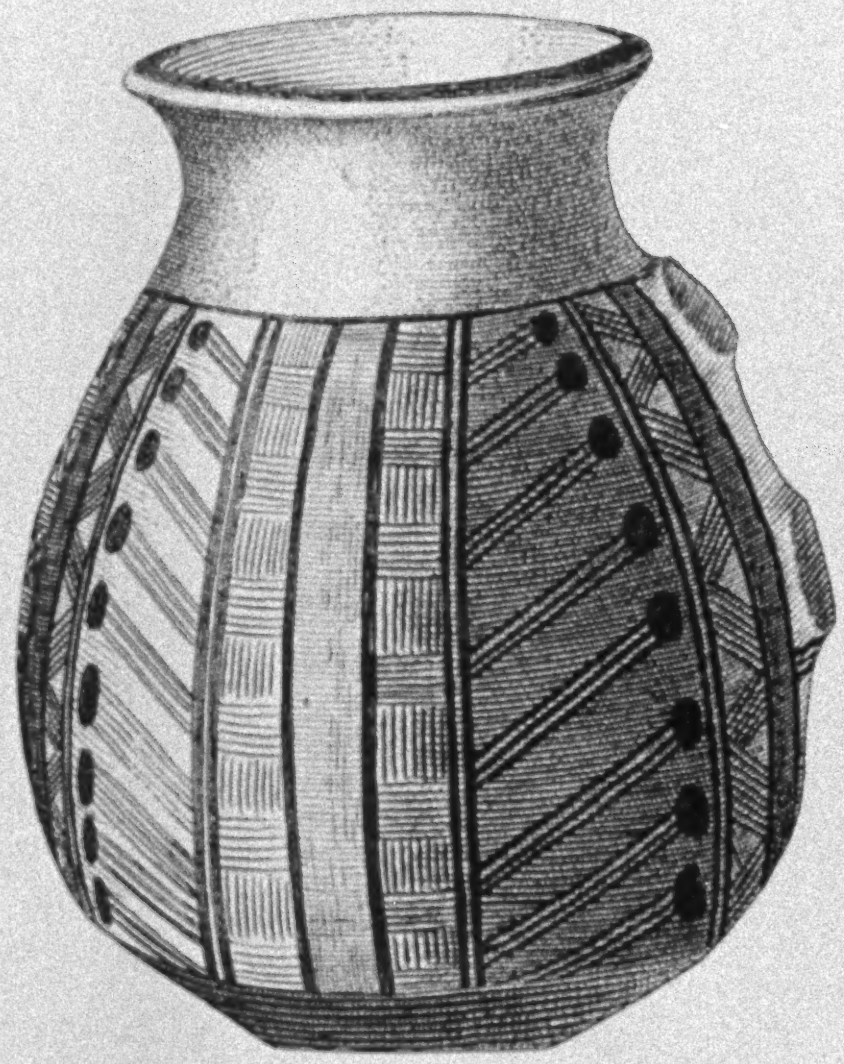
AN ARYBALLUS, OR LARGE TWO-HANDLED WATER JAR, OF THE SHAPE MOST CHARACTERISTIC OF INCA CIVILIZATION: MACHU PICCHU

The decoration is a remarkably complex one, worked out in three colors, with an intricate system of scrolls and geometric patterns. In carrying these jars on the back and shoulders, according to the customary method, a rope was used to secure them. This rope, passing over the shoulders and through the handles, was fastened to a projecting nubbin, usually made in the form of a grotesque animal's head, on the shoulder of the jar near the neck. There is almost nothing in the decoration on the side of the jar opposite to this nubbin. When the jar was carried on the shoulders, that side, of course, was practically invisible; so there was no object in decorating any but the outer surface. ¼ natural size.



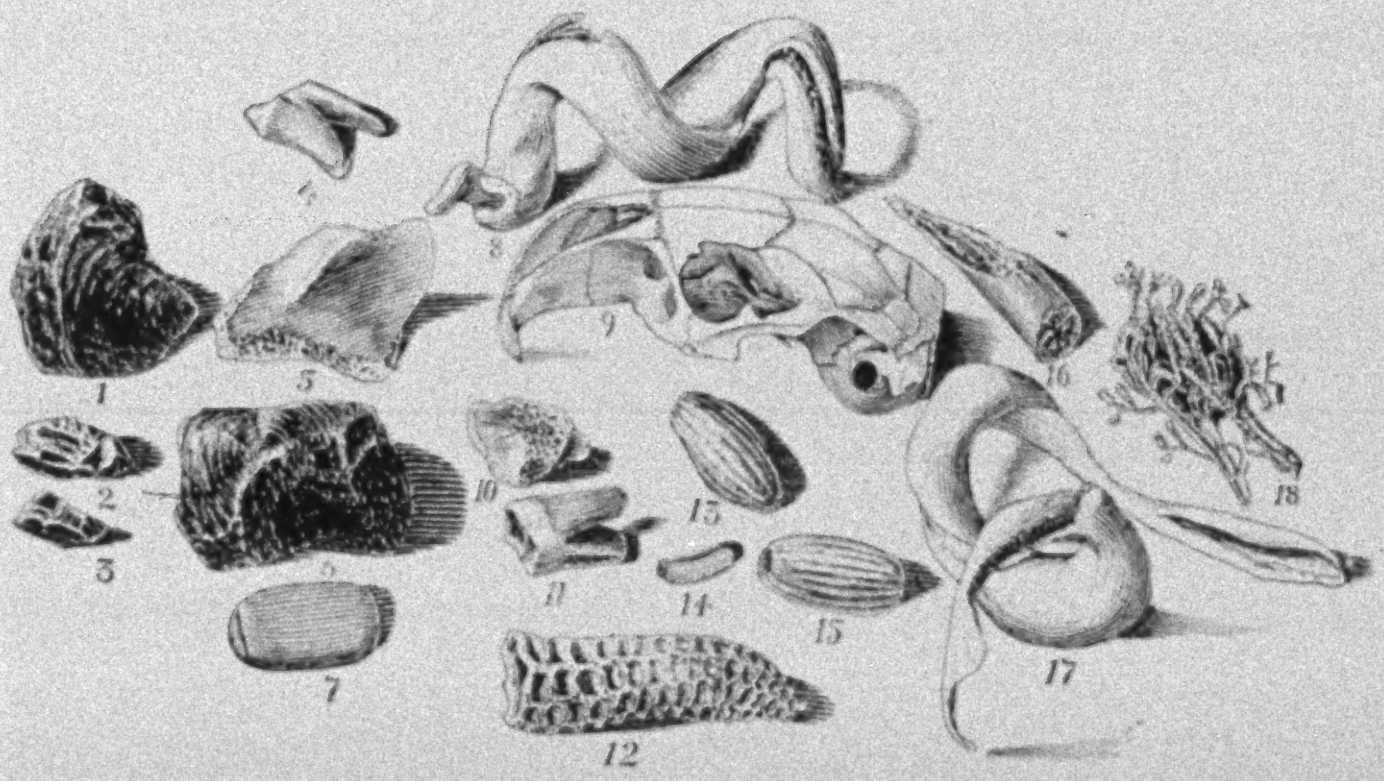
A TYPICAL INCA JUG, DECORATED WITH A HUMAN FACE, PARTLY IN RELIEF AND PARTLY PAINTED

The front shoulders of the jug are decorated with a necklace pattern consisting of small bronze or silver disks suspended from a single string. This necklace pattern was worked out by the Incas in various ways. ¼ natural size.



A SORCERER'S JAR, FORMERLY A ONE-HANDLED JUG FROM WHICH THE HANDLE HAD BEEN REMOVED AND THE NUBBINS RUBBED DOWN

This jug was found in a cave above the city and contained an extraordinary variety of articles, as shown on the following page. From their complexity and their resemblance to some of the great remedies still sold in the plaza of Cuzco and used by the Indians, we believe that this jug belonged to a sorcerer, or medicine man.

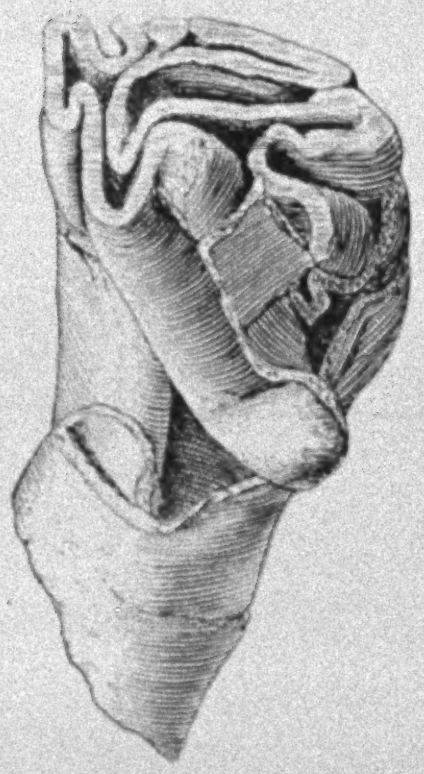


THE CONTENTS OF THE MEDICINE MAN'S JAR SHOWN ON THE PRECEDING PAGE

(1) a piece of charcoal; (2 and 3) pieces of a bright, shiny mineral rock; (4) a tooth; (5) a piece of charred bone; (6) charcoal; (7) a seed; (8) a dried seed pod; (9) a skull of a small mammal, possibly a guinea-pig; (10) a piece of bone; (11) a tooth; (12) a small corn-cob, less than two inches in length; (13 and 15) another kind of seed; (14) a small tooth which probably fell out of the skull; (16) a small piece of wood; (17) a seed pod; (18) dried moss.

THERE IS NO PART OF THE WORLD WHICH OFFERS TO THE SCIENTIFIC EXPLORER A MORE ATTRACTIVE FIELD THAN THE HIGHLANDS OF PERU AND BOLIVIA

(SEE PAGE 210)



PERHAPS THE MOST IMPORTANT FIND AT MACHU PICCHU

It has been generally supposed that the ancient peoples of Peru did not know how to manufacture bronze, but that all their bronze was accidental. This picture shows a piece of pure tin, which had apparently been rolled up by the Incas or their predecessors like a sandwich. From it, it is supposed, slices were cut when the artisan to whom it belonged needed tin in the making of bronze. It is a strong indication that the inhabitants of Machu Picchu knew how to make bronze. Most of the bronze utensils found in the city (see pages 171-184) contained from 5 to 9 per cent of tin and about 90 per cent of copper.

A WONDERFUL COUNTRY IN WHICH TO WORK

Finally, from the artistic and esthetic point of view, the magnificent scenery of southern Peru makes a very powerful appeal. The depth of the canyons, the height of the unclimbed mountain peaks, the numberless glaciers, the wide range of tropical jungles on the eastern slopes of the Andes, the magnificent roaring rapids of the Apurimac and the Urubamba, which go to feed the mighty Amazon, and the many vivid colors of the tropics—all add to the delight and enthusiasm of the explorer whose good fortune it is to work in this region.

They help him to forget the fevers and insect pests of the lowlands; the vampire bats of the middle valleys; the bitter cold of the nights in the uplands; the disagreeable features of mountain sickness; the physical discomforts of working at great elevations, and the lonesomeness of long separations from home and kindred.

Taking everything into consideration, I consider myself most fortunate in being enabled, through the interest and generosity of the National Geographic Society and of friends of Yale University, to conduct another expedition in this fascinating region.

Photo by Albert H. Bumstead

THE FIRST WIRELESS STATION OF THE NATIONAL GEOGRAPHIC SOCIETY–YALE UNIVERSITY EXPEDITION, ELEVATION ABOUT 13,000 FEET ABOVE THE SEA (P. 208)

MT. SALCANTAY, SHOWING THE CLOUDS WITH WHICH THE MAP-MAKERS HAD TO RACE EVERY DAY (SEE PAGE 208)

Photos by Albert H. Bumstead

ONE OF THE CAMPS OF THE NATIONAL GEOGRAPHIC SOCIETY–YALE UNIVERSITY EXPEDITION: SALCANTAY REGION, PERU

THE NATIONAL GEOGRAPHIC SOCIETY

AT A meeting of the Board of Managers, January 20, which was attended by every member of the Board in Washington, Mr. O. H. Tittmann, Superintendent of the U. S. Coast and Geodetic Survey, who for the past five years has been the Vice-President of the Society and was one of its founders, was unanimously elected President to succeed the late Henry Gannett, and Rear Admiral John E. Pillsbury, United States Navy, retired, was unanimously elected Vice-President. The other officers of the Society were re-elected.

President Tittmann was born at Belleville, Illinois, August 20, 1850. At the age of 17 he entered the United States Coast and Geodetic Survey and has worked his way up to the superintendency of that world-famous scientific bureau. During his career many notable experiences have been his lot. In 1874 he went to Japan as assistant astronomer of an expedition to observe the transit of Venus. In the years immediately following he was engaged in coast-survey work on both the Atlantic and Pacific coasts.

From 1889 to 1893 Mr. Tittmann was in charge of the United State standards of weight and measure. In 1890 he went to Paris to bring to the United States the standard meter which is now so carefully kept at the Bureau of Standards and which has become the basis of all our exact measures. At the same time he studied the systems of standards at Paris, London, and Berlin. He was a delegate to the International Geodetic Conference in Berlin in 1895, and became a member of the Permanent Commission of the International Geodetic Association in 1900.

In 1895 he became assistant in charge of the United States Coast and Geodetic Survey Office, and in 1899 Assistant Superintendent. His appointment as Superintendent of the Survey dates from December, 1900.

Mr. Tittmann was appointed to represent the United States in marking the boundary between Alaska and Canada, and in 1904 was appointed United States Commissioner of the Alaskan boundary and northern boundaries excepting the Great Lakes.

Rear Admiral John E. Pillsbury was born at Lowell, Massachusetts, December 15, 1845, and graduated from the United States Naval Academy in 1867, becoming an ensign in 1868 and a captain in 1902. For ten years he was engaged in coast-survey service, commanding the Coast Survey steamer *Blake*, during which time he made a very complete investigation of the phenomena of the Gulf Stream. He anchored the *Blake* in that ocean current and kept it there for a period of two years, observing the current at various depths below the surface by means of an instrument of his own invention. He established the position of the axis of the stream off Cape Hatteras and in the Straits of Florida and determined many of the laws by which its flow is governed. (See "The Grandest and Most Mighty Terrestrial Phenomenon," by John E. Pillsbury, in the NATIONAL GEOGRAPHIC MAGAZINE, August, 1912.) He commanded the dynamite cruiser *Vesuvius* off Santiago during the Spanish-American War. In 1905 he was chief of staff of the North Atlantic fleet, and chief of the Bureau of Navigation in 1908-1909.

IMPORTANT NOTICE

Members of the Society are urged to remember the following facts:

All remittances covering annual dues, purchase of books, panoramas, maps, bound volumes, etc., should be made direct to the National Geographic Society, Washington, D. C.

Remittances should be made by New York draft, postal, or express money order. Cash should not be sent unless the letter is registered.

Inasmuch as the Post-Office Department does not reforward second-class mail, the GEOGRAPHIC MAGAZINE will not follow you unless you notify us of your change of address, giving the old address at the same time. It takes three weeks in order to make a change of address effective, because of the necessity of addressing 400,000 magazine wrappers in advance.

In sending in nominations please use the blank form always to be found in the back part of the magazine, or write for booklet of application forms, which will be furnished upon request.

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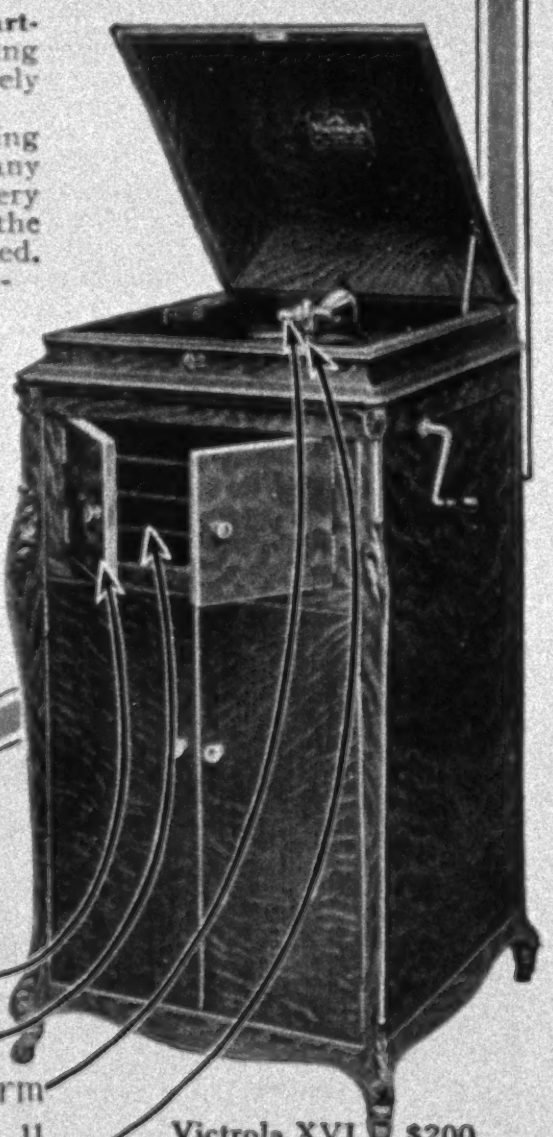

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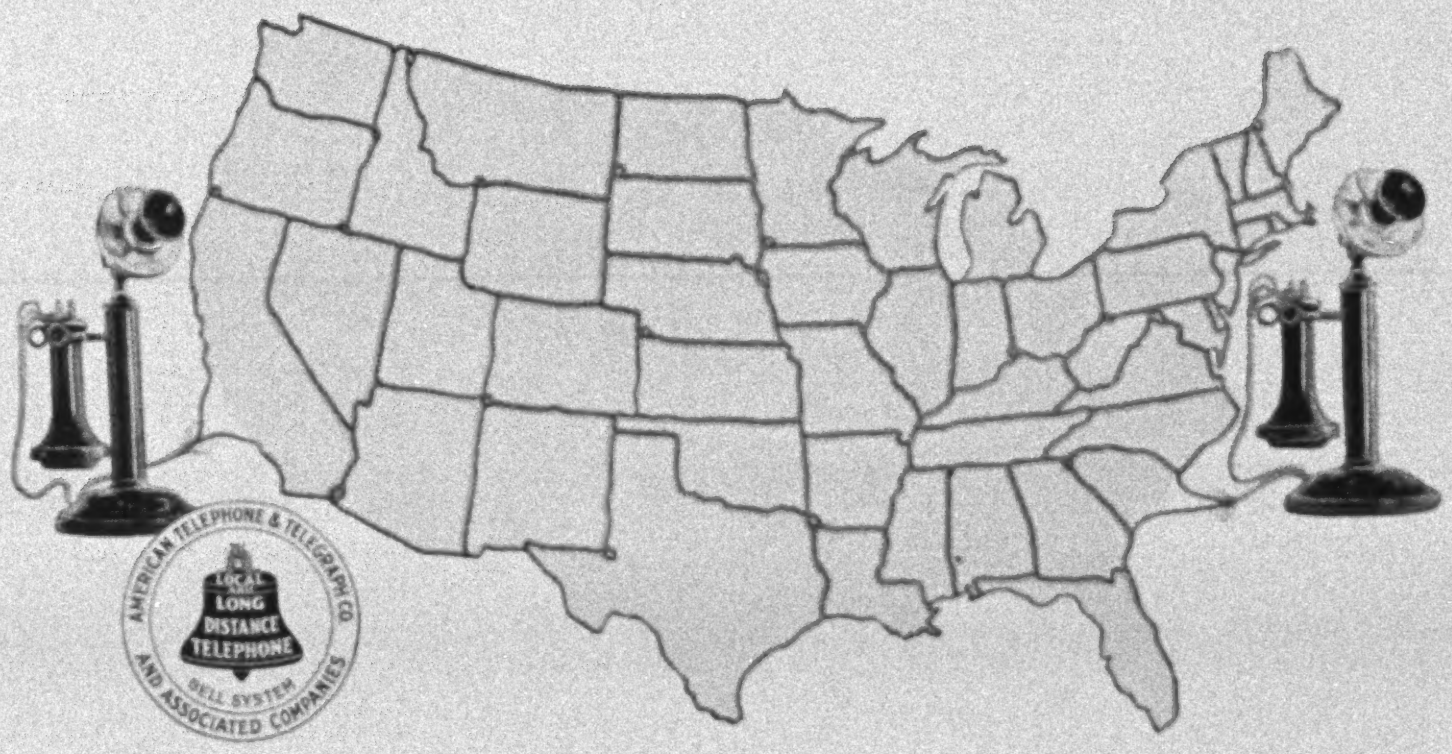

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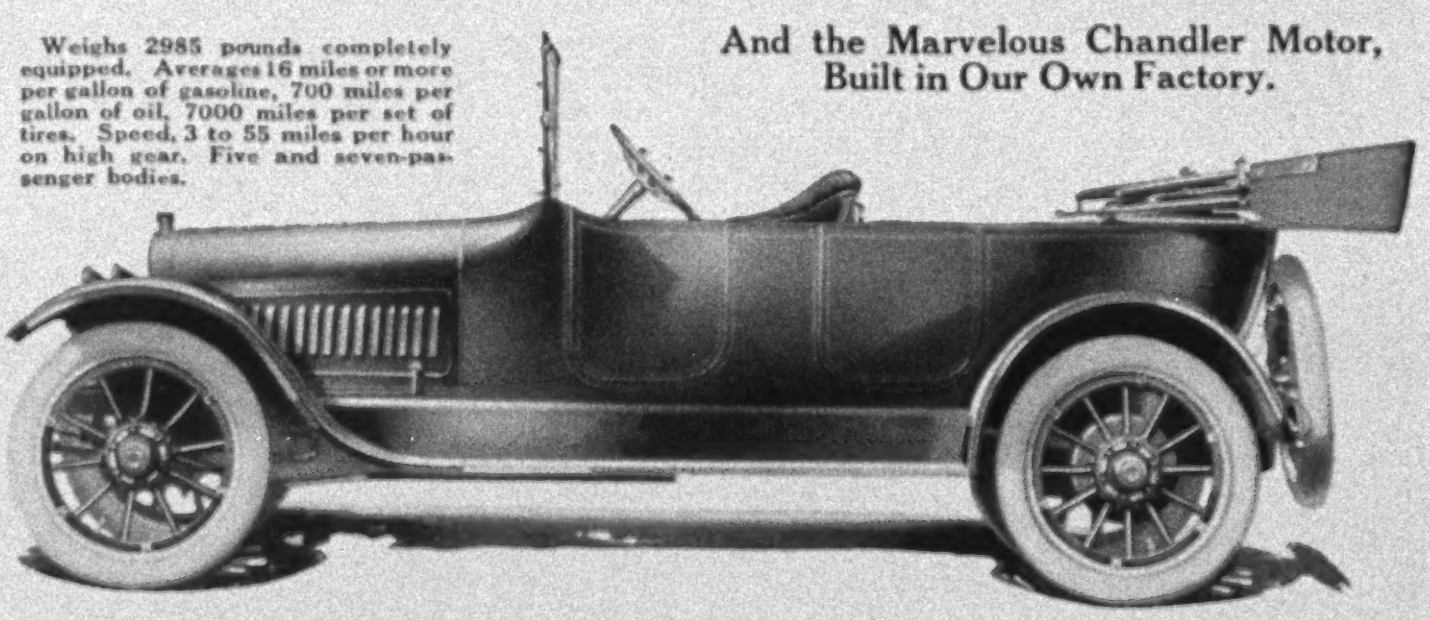

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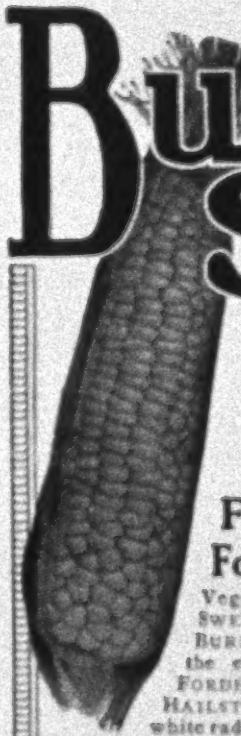

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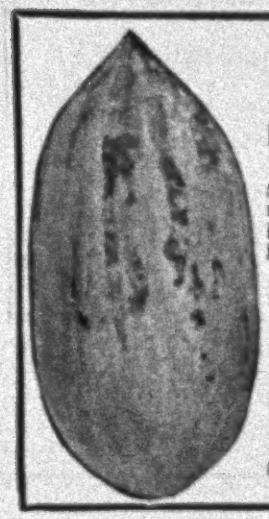

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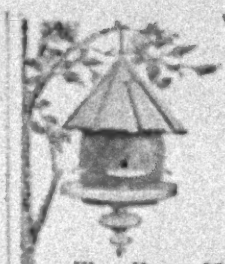

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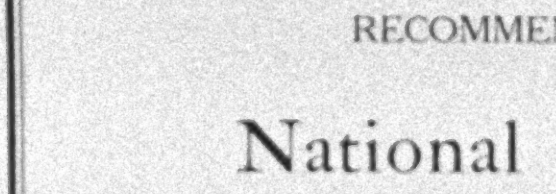

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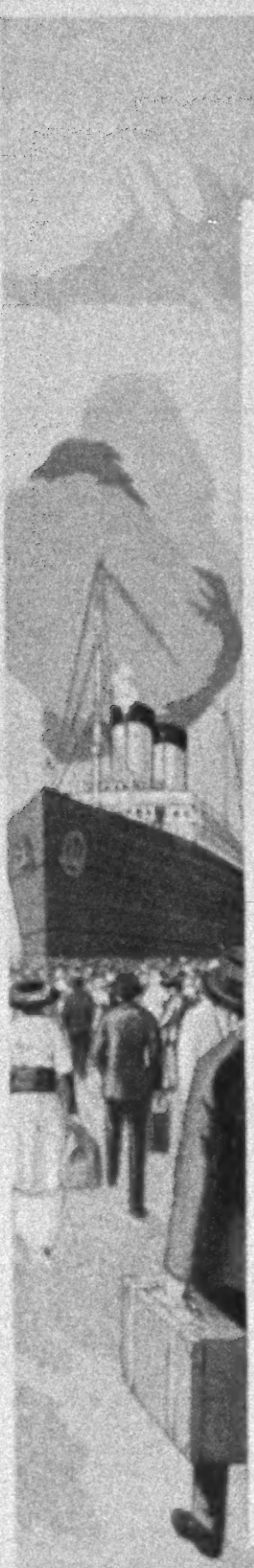

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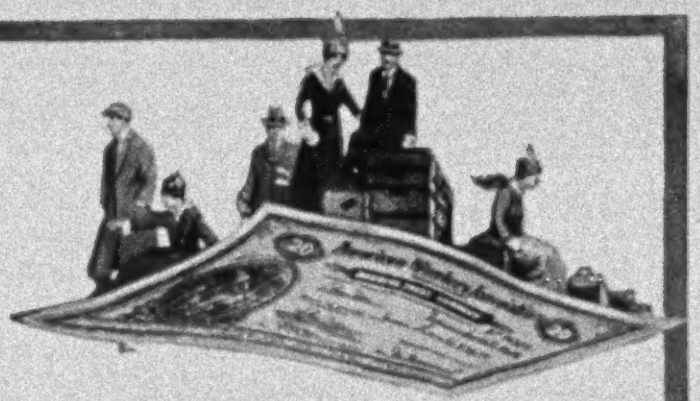

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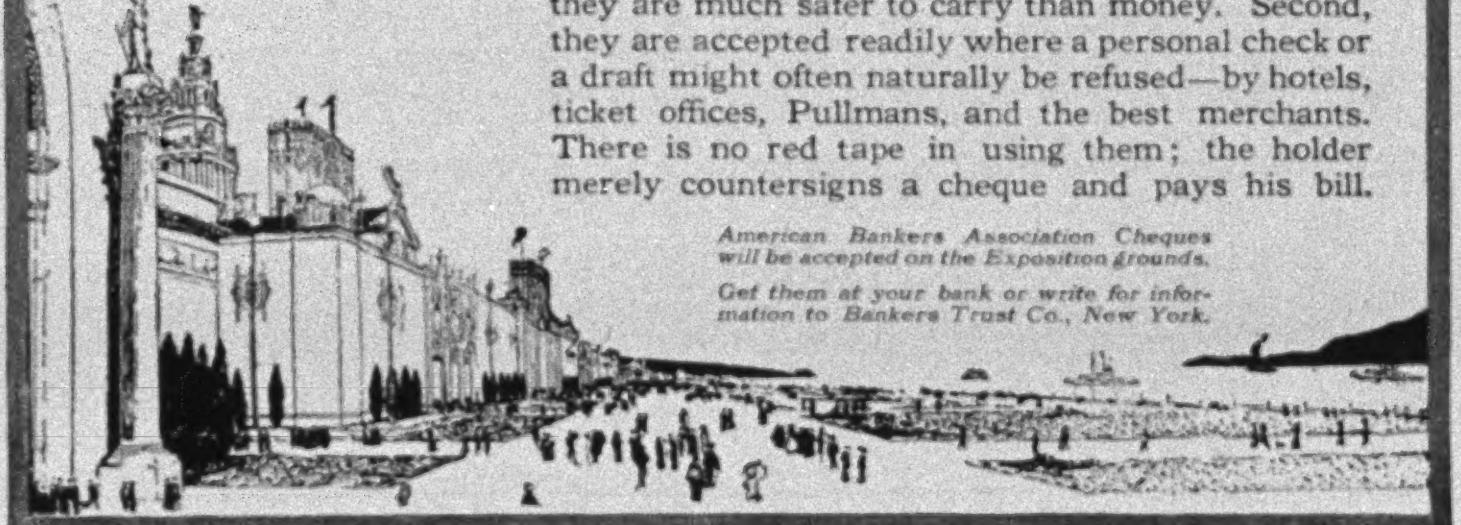

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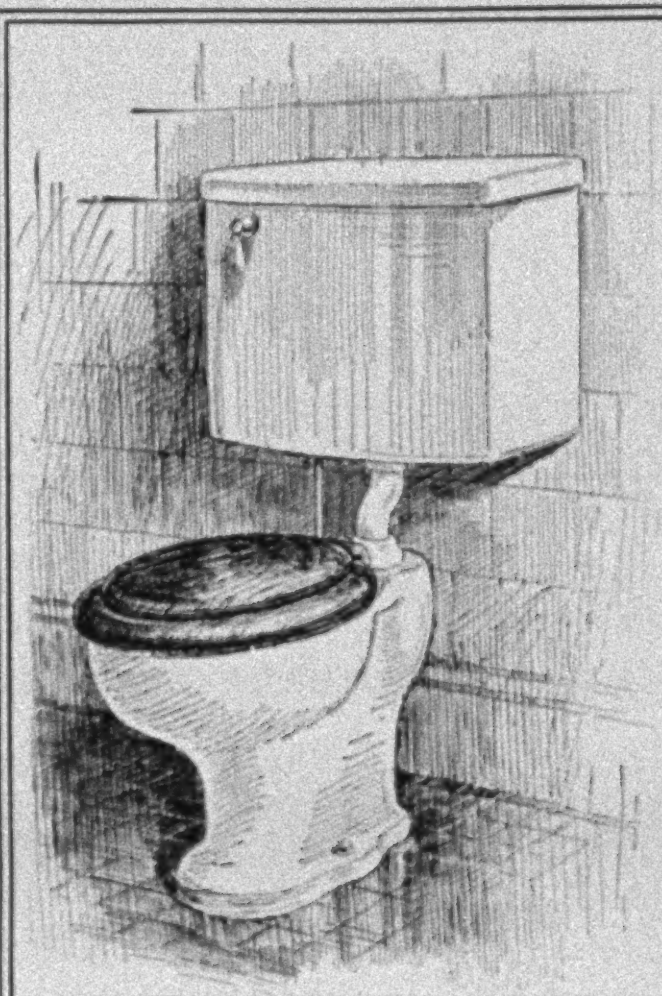

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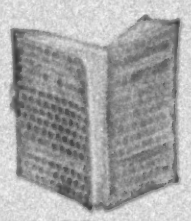

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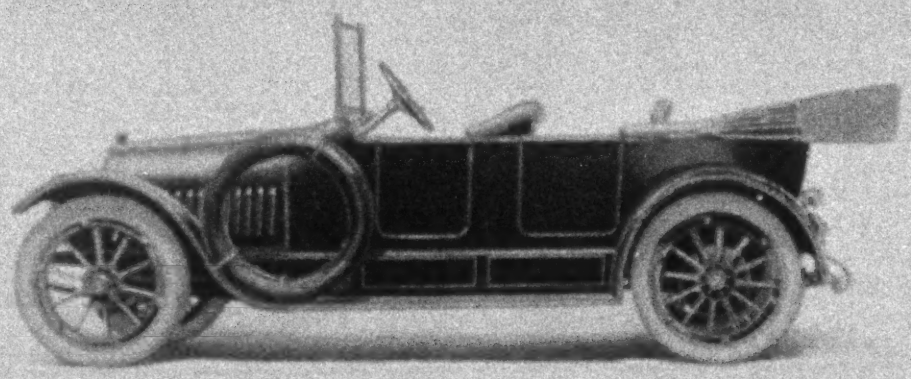

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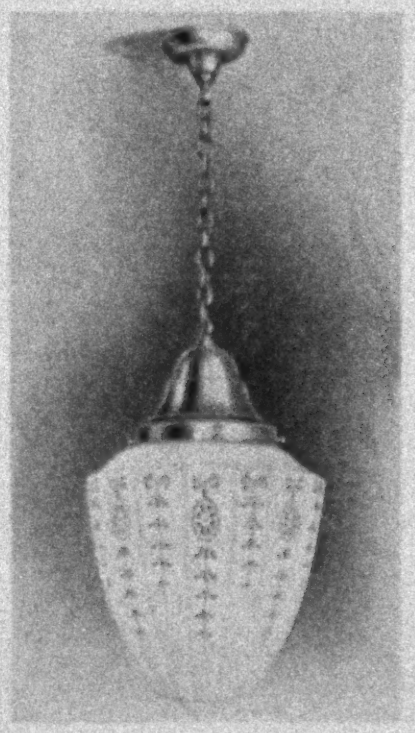

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